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ECLECTIC MANUAL, No. 4.

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DISEASES OF THE EYE,  
A HAND-BOOK OF OPHTHALMIC PRACTICE

—FOR—

STUDENTS AND PRACTITIONERS,

IN WHICH

PARTICULAR ATTENTION IS GIVEN THE TREATMENT OF  
DISEASES OF THE EYE BY ECLECTIC MEDICATION.

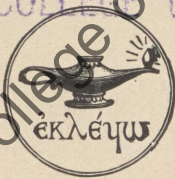
—BY—

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Association, etc.

WITH 193 ILLUSTRATIONS AND 4 PLATES IN COLOR AND  
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ILLINOIS COLLEGE OF OPTOMETRY



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TO MY FATHER,  
WILLIAM K. FOLTZ, M. D.

WHOSE TEACHINGS AND ADVICE

HAVE BEEN OF INESTIMABLE VALUE TO ME IN MY LIFE WORK,

THIS VOLUME IS

AFFECTIONATELY DEDICATED

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## PREFACE.

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Not that there is a dearth of works on the eye, but because, almost without exception, little attention is given to internal medication in the treatment of eye diseases, has this book been written. The beginner is too often discouraged in referring to works on the eye, in finding that restoratives, tonics, anti-syphilitics, and anti-rheumatics, constitute nearly the entire range of constitutional treatment. That drug action is the same in ocular lesions as in other organs is unquestionable, but this fact is ignored, as a rule, and the local application of remedies alone is usually dwelt upon to the exclusion of other equally as important measures. While the specialist in his practice relies upon constitutional treatment in the majority of his cases, when writing a work for students and the general practitioner, the importance of such measures appears to be forgotten or accepted as being familiar.

It has therefore been the purpose of the writer to give as explicit directions for Eclectic internal medication as possible, along the line of "specific medication," and, it may be added that "specific diagnosis" is as important here as it can possibly be in any disease. No organ of the body is more important than the eye.



Credit to others has been freely given, but the names of all contributing to this field would include nearly the entire medical profession. The list of books referred to, are those used the most freely. Besides the special journals devoted to this subject, the writer is indebted to numerous other authors and medical journals which have not been mentioned.

The writer wishes especially to thank Professor John Uri Lloyd for suggestions regarding nomenclature, and for reading the manuscript; W. B. Saunders of Philadelphia for numerous cuts; also Lea Brothers & Co., Wm. Wood & Co., P. Blakiston, Son & Co., Boericke & Tafel, and Franz Deuticke, of Vienna, for the use of illustrations; Standard Optical Co., of Cincinnati, for cuts of ophthalmological instruments, test-types, etc., Max Wocher & Son for cuts of eye instruments and the ophthalmoscope.

In this line of work, as in general practice, the best results can be obtained only by the use of the best drugs. The writer uses the "specific medicines," and unless otherwise specified these are understood throughout the text.

Perfection is not claimed for this book. The author offers it as based on the practical experience of years in the field covered by the work.

KENT O. FOLTZ, M. D.

CINCINNATI, O., September, 1900.

## INTRODUCTION.

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FOR the purpose of studying the action of drugs on the tissues of the eye, it is important that a full understanding of the character of the structures should be borne in mind. If a drug seems to possess an affinity for a certain class of tissues, it is to be expected that we will find other structures having the same embryological origin, similarly influenced by this same drug. All the tissues and organs of the body are developed from three primary germ layers, viz., ectoderm, mesoderm, and entoderm.

"From the external or ectodermic, is developed the epidermis, sensory epithelia of the sense-organs, brain, nerves, hair, nails, and superficial dermal glandular structures, enamel of the teeth, epithelium and glands of the mouth, and epithelium of the nose. The middle or mesodermic layer supplies the bones, muscles, cartilages, connective and adipose tissue, heart, blood and lymph vessels, blood and lymph corpuscles. The inner or entodermic layer supplies the epithelium of the alimentary canal and of the lungs, the secretory cells, ducts, and alveoli of the glandular appendages of the alimentary canal, as the liver, pancreas, etc.; while the smooth muscular fibres of the walls of the alimentary canal, and the vascular, adenoïd, and connective tissues generally of its appendages are of mesodermic origin.

"The eye is developed from two of these layers. The ectoderm and mesoderm supplying all the material required for the production of this important special sense organ. The



lens, retina, optic nerve, pigmented choroidal epithelium ; the cornea, conjunctival, and third eyelid epithelia ; the ocular nerves, blastema of the nasal duct, lachrymal glands and ducts, the Meibomian glands, and eyelashes, are ectodermic. The muscles, vessels, supra-choroid, sclerotic, the deeper layer or chorium of the cornea, the anterior layers, vessels, and muscles, the iris, aqueous and vitreous humors, as well as the bones of the orbit, are mesodermic."—*John A. Ryder, Ph D.*

The generally accepted plan of treating the eye as an independent and isolated organ should be abandoned, not only on account of the close relationship existing from the standpoint of embryology, but also on account of the influence exerted by remote structures. Constitutional treatment is too often neglected in treating these cases, evidently ignoring the fact that drug action is always the same on tissues of the same origin, even when there is specialization of these structures. This defect does not apply in all cases, but so often that it is likely to mislead the beginner in eye work. The evident increase of eye disease, and the prevalence of glasses even among children, should cause every physician to study the eye sufficiently to advise his patrons intelligently regarding the care of these important organs, as well as to recognize at least the more common affections of the eye that he will see in his general practice.

Many general diseases affect the eye, either primarily or secondarily, and where there is a chance for such complications, if watched for and understood, it will often save much suffering to the patient. Every physician can call to mind cases in which eye diseases set in, either during or following sickness of tissue remote from the eye, and yet which are even directly traceable to the morbid condition.

## CHAPTER I.

### EXAMINATION OF THE EYE.

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THE method employed in examining the eye should be made a matter of routine, otherwise one may overlook an important point. A careful record of each case should be kept, as in this way the condition at different times can be compared. After getting the history of the patient, including age and occupation, as well as their description of the trouble, commence your examination, being careful not to be misled by previous statements. If disease of the deeper structure is suspected, the close inspection of the eye should be preceded by ascertaining the visual acuity. This should be carefully preserved on the record, as at times it will be found very useful.

Notice the general contour of the head, position of the eyes, and the general appearance, not only of the eyes, but also of the face and body as well. Do not forget that the general health plays an important part in eye affections. Commence with the lids, notice whether they are swollen, reddened, or only partially opened; the edges reddened, eye-lashes matted together, parasites among the cilia, lashes diseased, the eyeball too prominent or seemingly retracted in the orbit; lachrymation normal, increased or diminished, shown by the appearance of the conjunctiva; and the character of the secretion, mucous, muco-purulent, or purulent. The conjunctiva reddened, the increased redness due to simple increased arterial supply, or impeded venous return; diffuse or circumscribed inflammation; blood-vessels movable with the conjunctiva or not, red band around the cornea, thickened condition of the mucous membrane; blister-like elevations over



the scleral surface or at the sclero-corneal margin ; cornea as to clearness ; aqueous, whether clear or turbid, and the iris, whether it responds readily to light, and is clear in color or muddy looking ; the pupil, whether central, round, and reacts to light readily, or is sluggish in its movements, dilated or contracted, and also as to any cloudy appearance, as cataract if fairly advanced, can be readily distinguished, as a rule.

During this part of the examination the mobility of the eyeball can be determined, and also any tendency to divergence from the median line, if close attention is paid to the case, can be seen. Spasmodic contraction of the muscles of the face and lids will also, as a rule, show during this part of the examination.

Eversion of the upper lid should then be made, as in many cases the cause of the trouble will be found here. The method of everting the upper lid is not difficult to learn, but will require practice before it can be done without causing some pain to the patient. If the eyelashes are present, catch them about the middle of the lid between the thumb and forefinger, direct the patient to look downward, draw the lid down and out, not using undue force, place a probe or any slender instrument at the upper border of the tarsus, then draw the lid outward and upward, using the probe as a fulcrum, when the lid will be turned so the conjunctival surface will be exposed. The direction given for placing the thumb or finger against the lid and turning it, is not one that should be tried by the novice, if the lashes are present, as the pain is too severe. If the lashes are absent, however, the method described will seldom be successful. The following procedure will be found applicable in the majority of this class of cases: Place the thumb against the cheek with the tip resting close to the edge of the lid, then with the index finger of the disengaged hand press the upper lid downward over the lower lid, which is pushed upward with the thumb ; have the patient look down, keeping the lid tense by means of the

finger, deliberately raise the thumb, keeping the tip as a fulcrum, and in the majority of cases the lid will be everted readily, and without much discomfort to the patient.

Examine the conjunctival surface carefully, noting all deviations from the normal, the condition of the glands and edges of the lids. The corneal surface should also be closely examined at this time to see whether some condition previously overlooked may not be now seen. After completing this examination, direct the patient to look up, at the same time giving the lid a slight push downward, when the lid will resume its natural position. The lower lid should then be everted; this is easily done by placing the index finger or the thumb close to the edge of the lid and pulling downward, thus exposing the inner surface fully, especially if the patient looks upward. The use of a magnifying lens will be found advantageous in making these examinations, as at times a very minute foreign body may be detected which it would be impossible to discover with the unassisted eye.

The puncta should be inspected to see whether they are open or not, and pressure should be made over the lachrymal sac to express any secretion present, noting its character. If secretion is obtained from the sac do not forget to examine the nose, as swollen turbinated tissue may cause occlusion of the nasal opening of the nasal duct, preventing the escape of the tears, which in a short time will become muco-purulent in character and may lead to an unjustifiable operation on the canaliculus, when proper treatment applied to the nasal cavities would relieve the difficulty.

Oblique illumination is very important for determining the condition of the corneal tissue, anterior chamber, iris and lens, unless the pupil is contracted, and even then it will reveal many pathological conditions. Artificial light is the best for this work, and the patient should be placed so the light is one side and somewhat in front of the eye. The light should be on a movable bracket, and so arranged that the intensity can be varied at will, too strong illumination



sometimes hiding very slight cloudiness of the part under examination. Use a two-inch or a three-inch lens to concentrate the light on the cornea, another lens of similar power is held in the hand, through which the examiner scans the structures. Varying the distance of the lenses will allow one to examine, not only the different layers of the cornea, but also the aqueous, iris and lens.

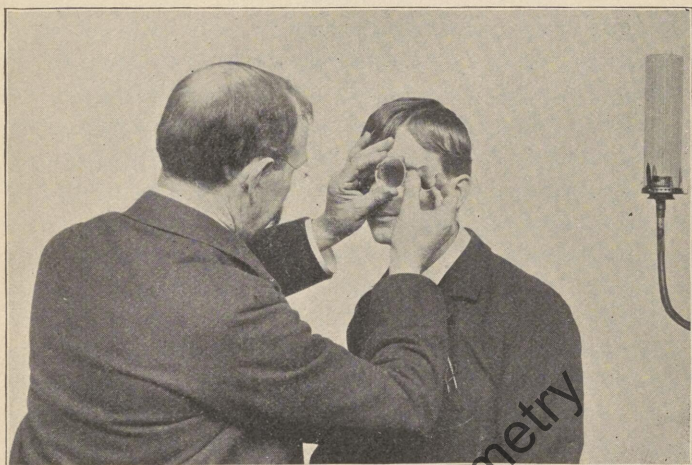


FIG. 1.—Oblique Illumination.

A favorite method is to adjust the head mirror and use this for illuminating the eye, handling the objective lens the same as before. For removing minute foreign bodies from the cornea it leaves one hand free for using an instrument, and does away with the uncertain light when the condensing lens is in the hands of an assistant. The careful examination of the eye by oblique illumination will give an idea of the condition of the eye impossible by any other method.

IRIS.—Inspection of the iris should always be made, as discoloration of this membrane indicates iritis or cyclitis, and is nearly always present in the early stages of iritic inflammation, and when the eye-ball is reddened it should

be watched for. Do not make the mistake of thinking a foreign body is present in the corneal tissue because spots of pigment are sometimes seen in the iris, which might easily be mistaken by the superficial observer. The method of oblique illumination should eliminate such an error. The mobility of the iris is determined, if in the daytime, by placing the patient near a window, and having the eyes fixed on some distant object, covering one eye with a dark colored card or the hand. After a few moments uncover the eye and notice whether the pupils are the same size. In normal eyes the pupils are the same size when one or both are exposed to light. When both eyes have been covered for a short time and then are exposed to moderate light, the pupil will be found to contract, then dilate and again contract until they come to rest. This motion is called "hippus," and is exaggerated in many nervous conditions, viz., hysteria, mania, etc.

It should be borne in mind that the pupil contracts in bright light, looking at near objects with convergence of the eyes, and in convergence without accommodative effort.

THE PUPIL.—The size of the pupil normally varies, as stated, with the intensity of light, convergence, etc. A light colored iris is usually associated with a small pupil, as well as in the aged, and those whose eyes are hyperopic. The pupil is generally larger in myopes, in those with dark irides, and in young persons. No more general rule for the size of the pupil exists than for the height of individuals, so all comparisons must be made by the observer.

A dilated pupil occurs in glaucoma, where no previous inflammation of the iris has bound it down to the anterior capsule of the lens. Disease of the orbit, the influence of the emotions, many diseases of the nervous system, and mydriatics cause dilatation of the pupil (mydriasis).

A contracted pupil is seen in congestive conditions of the iris, as iritis. This condition is also found in nervous diseases as well as many others. Certain drugs also produce



contraction of the pupils (myosis), and are called myotics. Unequal pupils are seldom seen, excepting in diseased conditions, or where some drug has been employed. If a patient presents, that has one pupil considerably dilated, and no lesion of the eye can be discovered, suspect a mydriatic. Myotics are seldom used unless under the direction of a physician, but the ubiquitous druggist will often dispense "eye-drops" containing a mydriatic. Unequal pupils often occur in those cases having marked differences in the refractive conditions of the eyes, and also when one eye is blind.

VISUAL ACUITY means the ability to distinguish the form and size of objects, and for the ready means of determining this a series of test types conforming to the results obtained by Snellen are usually employed. These letters subtend an angle of about 5' with the eye at the distance they should be read, which distance is designated by small figures or Roman numerals. These letters are so made that each stroke of the letter subtends an angle of about 1'.

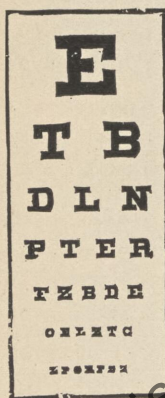


FIG. 2.—Test card.

The test card should be placed in a good light, and the light should never come from in front of the patient. The distance of the patient should be twenty feet from the card, if possible, as at this distance the rays of light are practically parallel, and the accommodative power of the patient is not called into play. The distance of the patient from the test card is the numerator of the fraction used to designate the acuity of the patient's vision. The smallest type the patient can read will be the denominator. If at twenty feet the type which should be read at twenty feet are distinguished with either eye, it shows distant vision is not impaired, though there may be slight hyperopia which will cause discomfort for close work. Remember, however, that a myopic person (near-sighted)

cannot read this line, but that because it cannot be read is not conclusive evidence of myopia. Hyperopia of considerable degree, and astigmatic conditions will lower the degree of visual acuity.

Having taken the distant vision, the accommodative power should next be looked after. This, in this country, is usually taken with the reading type of Jaeger, the No. 1

When, in the course of human events, it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume, among the powers of the earth, the separate and equal station to which the laws of nature and of nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation. We

representing normal vision with the ordinary power of accommodation. The accommodative power of course varies, but the following table is generally accepted as a fair average :

| Age.    | Diopters. | Inches   |
|---------|-----------|----------|
| 10..... | 14.00     | 2.81     |
| 15..... | 12.00     | 3.28     |
| 20..... | 10.00     | 3.94     |
| 25..... | 8.50      | 4.63     |
| 30..... | 7.00      | 5.63     |
| 35..... | 5.50      | 7.16     |
| 40..... | 4.50      | 8.75     |
| 45..... | 3.50      | 11.25    |
| 50..... | 2.50      | 15.75    |
| 55..... | 1.50      | 26.25    |
| 60..... | 0.75      | 52.49    |
| 65..... | 0.25      | 157.48   |
| 70..... | 0.00      | $\infty$ |

This table gives the total amount of accommodative power, and the near point given is obtained only with the fullest amount of effort on the part of the muscle of accommodation. This effort can only be maintained for a short time, and would be followed by many complications if kept up for any period.

At about the age of forty years, the loss of accommodative power is generally sufficient to cause the object to be held so far from the eye that the angle is diminished sufficiently to make it tiresome to read ordinary type; pain may be a factor, and if it is the patient will be more likely to seek relief than otherwise. This condition, in which the



work is held so far from the eye through loss of the power of accommodation, is called presbyopia, or the sight of old age as usually designated. This condition of requiring glasses for close work will come on earlier in persons having a hyperopic condition, as here the ciliary muscle has an extra amount of work to perform to overcome this error. If myopia however is present, the necessity of reading glasses will be deferred, and if the myopia is sufficient presbyopia so called, may not occur at all.

If the patient is under the age of forty, however, and the reading type is held at a point more remote than the table indicates for that age, it is good evidence of either hyperopia or astigmatism.

Astigmatism is a condition in which there is irregular curvature of the cornea or lens, usually the cornea, and prevents the formation of a perfect image on the retina under any circumstances. As a rule, except in young children and illiterate persons, the use of the astigmatic dial or Pray's astigmatic letters will determine the presence of astigmatism.

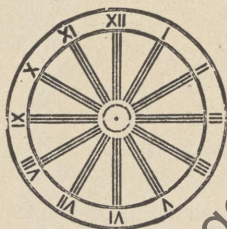


FIG. 3.  
Green's Astigmatic Dial.

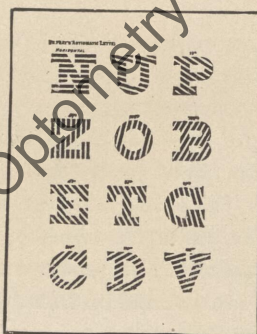


FIG. 4.—Pray's Astigmatic Letters.

When the examination has been carried to this point, the use of the ophthalmoscope naturally follows; if this instrument is used before taking the visual acuity, the retina is fatigued by the light thrown upon it, and the results of the test will not be as good as if taken before the ophthalmoscopic

examination. Expertness in the use of the ophthalmoscope is the result of painstaking work, and the examination of numbers of cases, as the normal eye varies in its appearance as much as the features of the face in different individuals, and what might be taken for a morbid condition by the novice would be recognized as normal by the experienced observer.

There are two methods of using the ophthalmoscope, the direct and the indirect. For the most of the work, especially for the purpose of gaining an accurate knowledge of the back



FIG. 5.—Ophthalmoscopic Examination. Upright or direct image.

of the eye, or fundus, the direct method is the one that will give the best results. The light used should be steady and bright. I prefer the argand burner, as the illumination can be easily regulated. The position of the light is important, as otherwise imperfect results will follow; the light should



be back of the patient and about on a line with the eye, and on the same side as the eye to be examined. The examiner should, if seated, sit as close to the patient as convenient and on the left side, for the left eye, and *vice versa*, keeping the body nearly parallel with the patient's. Revolving stools are most desirable, as the height can be adjusted so the eyes will be nearly on a plane. The ophthalmoscope should be held in the hand corresponding to the eye to be examined. Bring the instrument close to the eye, closing the opposite eye to see whether you are looking through the aperture of the instrument, then open the uncovered eye and throw the light from the ophthalmoscopic mirror onto the patient's eye. The examiner's eye should be from twelve to fifteen inches from the patient; as soon as the peculiar red reflex is seen from the pupil of the eye under examination, move toward the patient, keeping the reflex clear and distinct. When as close to the eye as you can get, an inch or less, the characteristic appearance of the retina and blood vessels should be made out. Such a lens as will give a clear and distinct view of the fundus should be brought in front of the aperture in the mirror of the ophthalmoscope; this lens should show the white line of light distinctly in the smaller blood-vessels and also bring out the stippled appearance of the retina. The observer should relax his own accommodation as much as possible, and this is best done by imagining he is looking at an object at a distance. However, there are some operators that can never relax their accommodation, and have to depend on other measures for determining errors of refraction.

Morbid changes in the retina, choroid, blood-vessels, and nerve, however, can be detected even without relaxation. In making this examination it is important that the patient does not look into the mirror, as this brings the macular region into direct line of vision, and, as a rule, not much can be distinguished, unless morbid conditions in this region are present. The macular region should be examined after the rest

of the fundus has been carefully scrutinized, so no changes escape observation.

Anomalies due to congenital conditions must not be confounded with pathological changes, else serious errors of diagnosis may result.

Opaque nerve fiber is one of the conditions that is most liable to confuse the beginner, as it may be diagnosed as albuminuric retinitis, posterior staphyloma, or an enlarged conus.

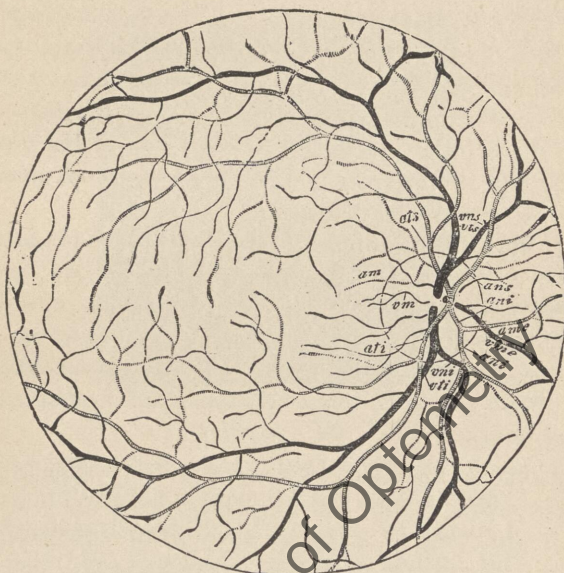


FIG. 6.—Diagram of Retinal Vessels—arteries light, veins dark. *ans, vts*, superior nasal vessels; *ats, vts*, superior temporal vessels; *ani, vni*, inferior nasal vessels; *ati, vti*, inferior temporal vessels; *ame, vme*, median vessels; *am, vm*, macular vessels.—Fox and Gould.

Physiological cupping of the optic disk may be mistaken for the early stages of glaucomatous cupping, but is not so deep nor broad as in the morbid variety. The lamina cribrosa, the net work of fibers at the bottom of the cupping, can



usually be distinctly seen when the proper lens of the ophthalmoscope is used.

The color of the retina varies according to the amount of pigment, from its absence in the albino to the dense stippling in the negro, and the differentiation of these conditions from the abnormal can only be made after considerable experience.

The landmark, which the observer tries to get, is the optic disk, or papilla. This is the intra-ocular ending of the optic nerve, and in the normal eye is easily distinguished if the positions of the eyes are correct. The disk is a little to the nasal side of the vitreous chamber, and usually circular, although sometimes oval, the long diameter being in the vertical axis. In astigmatism, especially of marked degrees, apparent changes of form are seen in the disk. High degrees of hyperopia and myopia cause the disk to look smaller or larger than the normal.

From the central part of the disk will be seen the diverging branches of the central retinal artery, unless the artery divides after reaching the surface of the papilla, the branches subdividing and reaching the different portions of the retina. The veins converge to the disk. The arteries are about one-third smaller, usually more tortuous, and lighter in color than the veins.

TENSION.—The term is used to indicate the firmness of the eyeball. The fluids in the eye maintain in health a certain firmness of the globe, which is easily demonstrated by palpation. The method of testing tension is by resting the tips of the index fingers on the closed lids, the eyes being directed downward, and the remaining fingers placed on the frontal and temporal regions so as to give steadiness to the palpating fingers. The pressure should be alternating, otherwise the tendency to push the eyeball backward into the orbit will frustrate the operator and the true condition will not be known. If the tension is but slightly changed from the normal, comparison will have to be made with the other eye, or with the eye of another person whose condition is

normal, preferably in a person of about the same age. These tests are of course comparative, as there is no definite measure for determining the normal resistance. Tonometers for registering tension have been made, but the educated finger used as described will be equally accurate. The tension is designated as Tn. normal. T? doubtful. +1. +2. +3. according to the degree of hardness of the eyeball, while the minus sign is used, as -1. -2. -3. when the tissues are softer than normal.

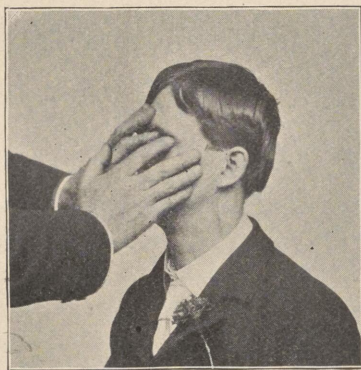


FIG. 7.—Determining the Tension.

**PROTRUSION OF THE EYEBALL (*Proptosis*).**—This condition may result from diseases of the orbital tissues, Grave's disease, paralysis of the ocular muscles, or following a tenotomy, but occasionally from intra-ocular conditions. Myopia may also be a cause. If but one is affected, comparative examination with the fellow eye will reveal the condition, but when both are more prominent, some systemic condition is evidently present, and if the protrusion is not very marked there may be difficulty in determining the amount of variation from the normal.



ENOPHTHALMUS.—An apparent diminution of the size of the eyeball or recession into the orbit. The latter condition may result from lack of the orbital fat, but may appear in some cases of ptosis. In high degrees of hyperopia, or defective development of the globe the former condition may present.

## CHAPTER II.

### DISEASES OF THE EYELIDS.

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#### ANATOMY.

In the normal individual, the eyeball is protected by two movable folds of tissue, the eyelids. The upper is by far the most movable; the motion being both voluntary and involuntary, the latter being effected by the orbicularis. The object of the lids is to protect the eye from injury by excluding excessive light and dust, and also to lubricate its surface by distributing the secretions of the glands.

The boundaries of the eye are, the upper, a nearly straight line, slanting a trifle downward at the outer part, the eyebrow. Externally by the border of the orbit; internally by the nose, and below separated by a curved line from the cheek; this is hardly noticeable in children and fat persons, but is quite prominent in lean people.

The skin over the superciliary eminence is loose and thick, so that it follows the pull of the muscles which are practically in it. The eyebrows may be raised on the forehead by the action of the frontalis muscle, or lowered by the action of the orbicularis. The skin surrounding the outer and lower side of the orbit is loosely attached to the underlying tissue, and also is much thinner than that of the superior



border. This skin may be easily thrown into folds by the action of the orbicularis and other muscles of the face. At the nose the skin is thinner and more firmly attached than at any other part of the orbital boundary.

The opening between the lids is called the palpebral fissure, and may be closed by drawing the skin outward. On the under surface of the roof of the orbit, running from the eyebrows backward, the skin thins considerably, and at the posterior attachment forms a fold, which in the majority of cases is quite deep; from this line it is turned forward over the tarsus.

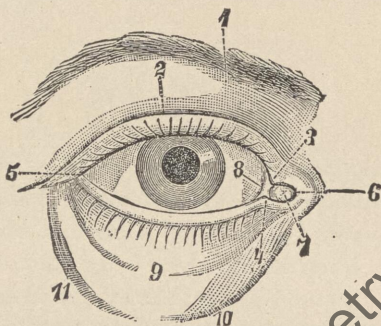


FIG. 8.—Right Eye and Surroundings. 1, superciliary eminence or eyebrow; 2, sulcus orbito-palpebralis; 3, 4, papilla lachrymalis, upper and lower; 5, outer canthus; 6, inner canthus; 7, lachrymal caruncle; 8, plica semilunaris; 9, sulcus orbito-palpebralis inferior; 10, 11, sulcus palpebro-malaris.—Noyes.

Near the edge of the lids the skin is closely adherent to the underlying tissues. The form of the palpebral fissure is rather oval, twenty-five to thirty millimetres ( $1\frac{3}{8}$  in. approximately) in length, and the breadth twelve to fourteen millimetres ( $\frac{1}{2}$  to  $\frac{3}{4}$  in.). The prominence of the eyeball also has an influence on the amount of space shown. The angles formed by the union of the upper and lower lids are called the canthi, and are designated as inner and outer. The outer canthus is acute, while the inner canthus is more rounded. The lachrymal caruncle is the small pinkish body situated at the inner canthus.

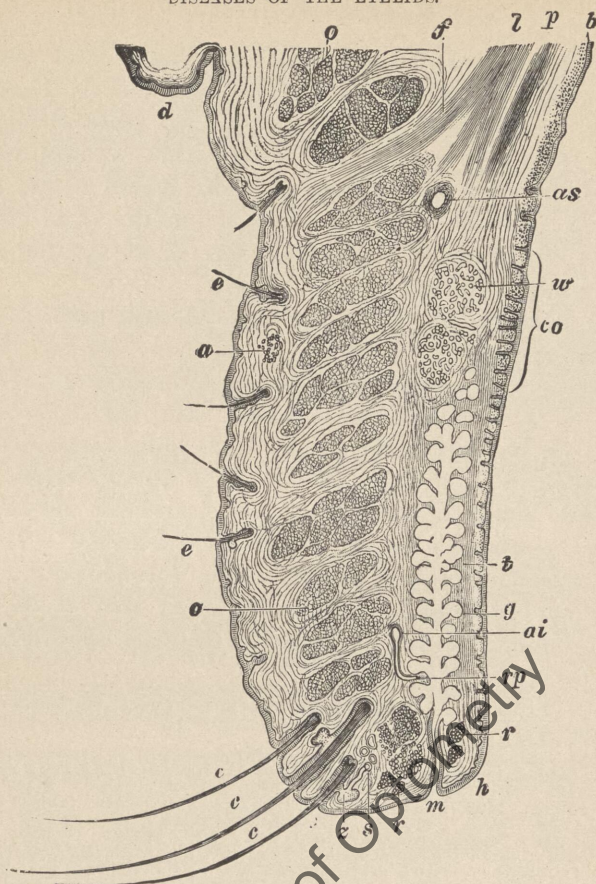


FIG. 9.—Perpendicular Section through the upper lid, magnified 5 xi. The anterior surface, covered by the skin. *d*, the skin above the sulcus orbito-palpebraris; *v*, skin at anterior edge of the lid; *e, e*, fine hairs in skin; *s*, sweat-glands; *c, c, c*, cilia; *z*, Zeiss' glands; *s*, modified sweat-glands; *o, o*, transversely divided bundles of fibers of the orbicularis; *r, r*, musculus ciliaris Rioli. The posterior surface is covered by the conjunctiva which at the fold of transition, *b*, shows an adenoid character, but over the tarsus, *t*, shows papillae, especially corresponding to the convex border, *co*, of the tarsus. *g*, meibomian glands; *m*, their orifices; *h*, posterior edge of lid; *w*, Waldeyer's mucous glands; *p*, Muller's musculus palpebraris superior; *l*, levator palpebraris superioris; from the latter a leash of fibers, *f*, passes to the skin of the lid. *as*, arcus tarseus superior; *ai*, arcus tarseus inferior, from which the rami perforantes, *rp*, run first straight downward, then backward through the tarsus.—Fuchs.



Near the inner canthus a small prominence will be seen on either lid, situated between the skin and mucous margins, and at the apex of each a small orifice, the punctum lachrymale; this is the opening into the canaliculus or canal which carries the tears to the lachrymal sac, thence to the nose through the nasal duct. The elevation on the upper lid is a little to the inner side of the lower one, so the lids can close more firmly than they would otherwise.

The blood supply of the lids and adjacent parts is very profuse, coming as it does from so many sources. Continuations of the ophthalmic and facial arteries at the nasal side, and a branch of the temporal near the upper outer angle are the largest as a rule. The lower lid receives its supply largely from the facial and infra-orbital arteries. At the outer angle, branches from the transverse facial and sometimes from the orbital branch of the middle temporal. The ophthalmic branch of the internal carotid through the lachrymal subdivision supplies the outer part of the lids, and through the nasal and frontal to the inner upper angle of the base of the orbit.

The lymphatics are arranged in two series, one before and the other behind the tarsus.

The sensory nerves of the upper lid and neighboring region come from the first division of the fifth pair. Above the orbit, the supra-orbital, and at the inner angle the supra-troclear. Both send branches to the upper lid which may also receive branches from the lachrymal nerve. The infra-troclear branch of the nasal nerve reaches the surface at the inner side of the upper lid. Several branches of the infra-orbital supply the lower lid. The motor branches from the facial nerve reach the orbicularis from the outer side.

The second layer comprises the orbicularis palpebrarum, consisting of two parts, the palpebral and orbital portion. The palpebral is confined to the lids proper, while the latter spreads out beyond the orbit, and is intimately connected

with the muscles of the forehead and cheek. The direction of the fibers of the palpebral portion run parallel with the edges of the lids; this should not be forgotten in operations. The nerve supply is from the facial nerve.

The third layer consists of the tarsus (improperly tarsal cartilage) and septum orbitale. The tarsi are composed of dense connective tissue which gets thinner at the edges, and grades into the surrounding membrane. They are convex outward, the concave surface conforming to the anterior portion of the eyeball. The membrane attaching the tarsus to the orbit is termed septum orbitale. The loose areolar tissue on each side of the septum orbitale is the seat of effusion in edema.

The fourth and last layer consists of the conjunctiva near the margin, back a little is Muller's muscle, and in the upper lid the levator palpebræ.

At the margin of the lids are two or three rows of short, thick hairs, called cilia and are curved with the convex side toward the margin of the lids. The life of the cilia is about three months. The hair follicles are surrounded by sebaceous glands and the glands of Moll (modified sweat glands). A deeper layer of glands, the Meibomian, are embedded in the substance of the tarsi proper, with their orifices opening in a row close to the conjunctival margin of the lids. These glands resemble sebaceous glands. The secretions from these various glands serve to lubricate the eye, and prevent the lids sticking together.

### CONGENITAL ANOMALIES OF THE EYELIDS.

ABLEPHARIA.—Absence of the lids. A rare defect, it may be either complete or partial.

CRYPTOPHTHALMOS.—An exceedingly rare anomaly. The lids being absent and the skin passing from the superciliary region to the cheek, covering the eyeball. The motion of the eye can be detected through this covering. The eye is seldom fully developed.



**COLOBOMA.**—A deficiency in the development of the lids, due probably to defective closure of the oblique facial fissure. The amount of the defect may consist simply of a notch, or it may be so extensive as to cause the major portion of the lid to be lacking. The upper lid is the most often affected, and the missing portion is generally on the nasal side of the middle of the lid. Other congenital defects are usually present, especially hare lip, cleft palate, etc. A plastic operation may be performed in these cases.



FIG. 10.—Epicanthus.—*Hansell and Bell.*

**EPICANTHUS.**—An excess of skin over the root of the nose, forming folds of tissue extending from the forehead to the side of the nose. This fold covers more or less of the inner canthi, in some cases being excessive enough to reach the nasal margin of the cornea, when the appearance of convergent strabismus is present. Defective development of the nasal bridge is often a cause of this condition, and congenital ptosis is often associated with it.

A slight epicanthus is frequently seen in the new born, but as nose and face develop it disappears. Subjects of hereditary syphilis most frequently lack nasal development, and the probability of this should be remembered in case of epicanthus. Heredity undoubtedly is an important factor. In one family under observation, some of the members of three generations were affected with epicanthus and congenital ptosis.

*Treatment.*—Operative.

NEVI.—A congenital condition. The appearance may resemble a burn of the lid in color, or it may be an elevated mass cavernous in character.

*Treatment.*—Removal is to be recommended, especially in the latter variety, as there may be extension to the globe. The method that will produce the least deformity is the one to be recommended. Excision if the growth is small; if large, destruction of the blood vessels may be obtained by means of the galvano-cautery or electrolysis. In the latter operation short sittings are preferable. Before resorting to radical measures a trial of a saturated solution of salicylic acid and Lloyd's thuja may be tried; this will destroy some of these growths, but will fail in others.

ERYTHEMA.—This may result from local irritation or disturbance of the circulation due to indigestion, dentition, uterine affections, influence of heat, etc. A passive hyperemia may result from prolonged bandaging of the eye. The majority of corneal and conjunctival diseases also produce an active erythema.

*Symptoms.*—Slight superficial redness, which disappears under pressure, and sometimes a slight swelling. A burning sensation may be noticed, but as a rule there is not much discomfort. Ordinarily lasts but a few days.

*Treatment.*—Find the cause. If due to simply local irritation, this will, if removed, effect a cure. A mild soothing application will give relief, and the use of distillate of hamamelis, or boric acid ointment (gr. xvi to 3j of base). Any constitutional disturbance should be looked after.

ECZEMA.—Eczema is a painful disease in this location, and occurs in the same forms and from the same causes as affect the skin elsewhere. The swelling is greater, and may be sufficient to close the eyes.

*Treatment.*—Locally in the acute stage oxide of zinc ointment or boric acid ointment will usually be found to give



relief. Compound stearate of zinc with salicylic acid (mild) will relieve the irritation, thus allowing better results from constitutional remedies. In the chronic form, scaly or exudative, salicylic acid ointment has given good results.

R—*Acidum salicylicum* (Lloyd's), grs. v-x; vaseline (album), ℥j. Mix. Apply lightly on the lids, taking care not to get any into eye.

Internally the use of *jaborandi* in doses of gtt. j-ij four times a day, will be found useful in the dry form of the disease. *Liquor potassii arsenitis* in fractional drop doses, in chronic eczema, will often effect a cure. Iodide of arsenic, 1·200—1·100 grain doses, has given good results in scrofulous cases.

**ERYSIPELAS.**—As a primary affection erysipelas seldom attacks the lids, but may extend from contiguous regions. The swelling of the lids may be extreme, and danger to the eye should be borne in mind as infection of the orbital tissues may occur. The inflammatory process may extend to the brain membranes, causing death. The red, shining, and later, brawny swelling, with formation of cutaneous vesicles and small abscesses, are characteristic. The superficial form is not dangerous, but the phlegmonous must be viewed with apprehension.

*Treatment.*—Locally the application of some mild unirritating powder, as oxide of zinc, rice flour or compound stearate of zinc with salicylic acid (mild) may give relief. More reliance must be placed on internal medication however. *Aconite* or *veratrum* is indicated in the majority of cases to control the febrile condition. *Rhus tox.* is often combined when the burning pain is present, as well as with elevated papillæ at or near the tip of the tongue. *Apis* with the stinging pain and edema. *Belladonna* will also give relief in some cases. *Echinacea* has been highly extolled in the sloughing form, both locally and internally.

**RHUS POISONING.**—This is a frequent cause of violent inflammation of the lids as well as of the face. It is the

result of contact with "swamp sumac" (*Rhus venenata*), "poison oak" (*R. toxicodendron*), or "poison ivy" (*R. tox. var. radicans*). Some persons can not even get close to the swamp variety if the wind is coming over the bushes, especially if moist. The smoke from the burning of either of the three forms will also cause susceptible persons to be poisoned. The skin is a deep red color, and edema of the subcutaneous tissue is quite marked. The lids present a puffy appearance and the swelling may be so marked as to close the eyes entirely. Vesicles appear which may become confluent, and exude a straw-colored fluid which dries in thin soft crusts. The earlier symptoms are itching and burning of the skin.

There seems to be a chronic form of this disease which recurs year after year, and always at about the same time as the first attack. These cases have all the characteristic symptoms of the initial attack, only usually not so severe in form.

*Treatment.*—In the acute stage of the inflammation, the application of a solution of hyposulphite of sodium (3j to water 3xvi) will generally give prompt relief. If this solution causes too much pain it should be reduced. Chloride of ammonium, 3ss to water fl.3xvi, has also given prompt relief. This can be used locally and at the same time a teaspoonful of the preparation taken every two hours. A cloth should be placed over the affected area, kept saturated with either of the solutions. Internally, if there is much fever, aconite should be used. The addition of *rhus tox.* in very small doses does well in some cases. *Echinacea* has been recommended. *Apocynum* is valuable where there is much effusion into the intercellular tissues.

In the chronic form I have had better results from the use of *rhus tox.* internally, giving small doses. This is usually combined with *liquor potassii arsenitis*, giving fractional drop doses. Locally the same treatment as in the acute form.



**MILIUM.**—Milia are small round, usually pearly appearing bodies, about the size of a millet seed, from which they derive their name. Consists of a distended sebaceous gland, the opening having closed, and the sebum accumulated.

*Treatment.*—Incise with a small, sharp knife, and express the contents.

**MOLLUSCUM EPITHELIALE** (molluscum contagiosum) is a small rounded, dingy-white tumor, sometimes the size of a pea, usually smaller. The top is flattened and usually presents a dark spot in the center, representing the aperture of a follicle. It contains a cheesy mass of degenerated epithelial cells. By some considered contagious.

*Treatment.*—Incise and squeeze out the contents.

**LUPUS.**—This disease rarely attacks the lids primarily, but extends from the nose or cheek. There is a chance of confounding this disease with epithelioma or syphilitic ulcer.

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#### DIFFERENTIAL DIAGNOSIS.

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| EPITHELIOMA.                            | LUPUS.                                             | CHANCER.                                 |
|-----------------------------------------|----------------------------------------------------|------------------------------------------|
| Indurated irregular edges.              | Less induration. More inflamed.                    | Indurated, but edges more rounded.       |
| Slow growth.                            | Growth slower than epithelioma.                    | Rapid growth. Usually in young subjects. |
| Lymph glands of neck involved late.     | Lymph glands involved late.                        | Lymph glands early involved.             |
| Attacks middle-aged and elderly people. | Generally associated with lupus elsewhere on body. | Other symptoms of syphilis               |

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Lupus vulgaris is a cellular growth composed of variously shaped reddish tubercles, which usually terminate in ulceration and extensive cicatrization. The theory that it is tuberculosis of the skin seems the most plausible, though the true character has not as yet been definitely settled. Lupus granules are red and average about the size of a pin-head. After ulceration takes place, the points crust over, the crusts being broad, flat, and brown in color. The disease is most general in youth, and the progress decidedly slow. The discharge is scanty, and may or may not be offensive. Not much tendency to bleed when handled. Pain, if present, is

slight. The ulceration as a rule is superficial, and shows a tendency to heal at one portion and spread at another.

CHANCER.—The primary sore has been found on the eyelid, and the possibility of such a condition should be borne in mind. The skin is more likely to be involved than the conjunctiva. The glands in front of the ear are indurated.

Secondary syphilitic ulcer may occur from the breaking down of a tubercle of the skin, or of a gumma originating in the skin or submucous tissue and cartilage. Most frequently it is found near the lid margin or below the inner canthus. It may be mistaken for lupus or epithelioma, more likely the latter, as it at times is very difficult to distinguish between the two.

When situated over the lachrymal sac it may be mistaken for dacryocystitis. This ulcer may make its appearance so late that all other symptoms of syphilis have disappeared, making the diagnosis doubly hard. A prompt diagnosis is necessary in order to save tissue. Caustics are not only useless but dangerous. More reliance must be placed on constitutional treatment.

EPITHELIOMA.—This disease occurs frequently on the lids, and usually near the margin of the lower lid. The inner canthus is the favorite location. The upper lid is often implicated through extension. The superficial form commences in the upper layers of the skin as a flat, wartlike elevation, whose surface becomes excoriated and secretes a watery, viscid, or sometimes sanious fluid, which forms a brownish crust. Beneath this crust appears a superficial grayish excavated ulcer with a slightly raised base surrounded by indurated tissue. The growth is very slow, sometimes extending over a long period of years. The lymphatic glands are seldom indurated.

Rodent Ulcer (carcinoma, Jacob's ulcer), is classified with this form of epithelioma, and spreads slowly and extensively, attacking any tissue it meets. The growth starts as a pimple over which a crust appears. This tubercle involves the skin



and connective tissue. In time the tubercle breaks down, forming a deeply excavated ulcer about which the skin is infiltrated and congested. This form is much more serious than the superficial, it progresses more rapidly, returns more certainly after removal, and if unchecked invades the orbit, attacking periosteum, and conjunctiva, and the eyeball itself. In the latter stages lymphatics may be indurated. The disease usually occurs in elderly persons.

The slow growth, absence of lymphatic involvement, and the age of the patient aid in the diagnosis. Seldom occurs before the age of forty.

Lupus is more likely to occur in early life, the age of puberty being a favorite, although I have seen cases much older. The lupus ulcer is more inflamed and less indurated, the ulcerative points being multiple.

*Treatment.*—The treatment of lupoid and epitheliomatous growths is not eminently satisfactory. If there is not much involvement of tissue, the growth being circumscribed, excision is advised in either case. Care must be exercised to remove all morbid tissue. The edges may be approximated by sutures or adhesive strips, provided the traumatism is not too great, otherwise a plastic operation may be necessary. Curettage is recommended by some, as well as the cautery, both actual and galvanic. The use of caustic pastes is not advisable, as the deformity resulting is liable to be more marked. Carbolic acid has had seemingly a good effect in some cases, boring into the mass with a pointed splint saturated with the acid. In both forms of disease the use of salicylic acid locally has given good results. Care must be used in the use of caustic preparations about the eye, as they may do more harm than the disease.

Internally the use of phytolacca may at times modify or improve the diseased condition. Thuja, both locally and internally has been employed with satisfactory results in epithelioma. In fact there are but few remedies which have not been employed in the treatment of these diseases. Proper

hygienic conditions and improvement of the general health are most important.

**VARIOLA.**—Small pox pustules on the lids sometimes result in serious deformity. If confluent and deep, they may cause considerable loss of tissue; cicatrization following may cause ectropion. If the pustules form on the lid margin, the Meibomian ducts and cilia bulbs being involved, an obstinate marginal blepharitis may result with loss of lashes, or trichiasis.

*Treatment.*—Soothing applications which will protect the surfaces from the air. An ointment of boric acid, plain vaseline, or any favorite mild powder may be employed.

Conjunctivitis is frequently a complication of small-pox, and the eyes should be washed freely with the boric acid wash. If there is much pain the use of the following will usually give relief: R—Morphine sulphate, gr. j-ij; hydrastis (Lloyd's), fl. ʒss.; aqua distillata, q. s. fl. ʒss. Mix. This can be dropped in the eyes every two or three hours, and in the majority of cases will give prompt relief from annoying sensations.

**WARTS.**—These growths are generally near the margin of the lids, and are benign. In elderly people, through irritation, it is claimed, they sometimes assume an epitheliomatous nature. These growths are easily removed, either by the use of ligature or cutting them off with a fine scissors. The base should be touched with an ointment of salicylic acid. R—Acidum salicylicum (Lloyd's), gr. xx.; vaseline, ʒj. The acid should be rubbed with a few drops of glycerine before incorporating with the vaseline. The synthetic acid should not be used. Care should be exercised not to get any of the ointment into the eye as it will produce pain.

**HORN Y GROWTHS** (Cornu Cutaneum).—These are not often seen and are readily removed by cutting them off. The base should be cauterized after removal, and the ointment of salicylic acid will be sufficient in most cases.



**EDEMA.**—On account of the delicacy of the skin, its looseness of attachment to the underlying tissues, and its elasticity, serous infiltration is not uncommon in the lids. This disease is often the result of local congestion in the lids themselves, the conjunctiva, the orbit, or of disturbance of the general circulation. It is often an important symptom of disease of the heart or kidneys, arsenical poisoning, and trichinosis. If the swelling is so great as to interfere with the opening of the lids, evacuation of the serum, by puncture, and the application of a compress will give relief.

*Treatment.*—Find the cause if possible, and its removal will effect a cure. The use of apocynum in these cases will hasten absorption. Rhus tox. is also valuable when the swelling is accompanied with much stinging pain.

**ECCHYMOSIS.**—An extravasation of blood in the connective tissues of the lids. Direct contusion is the commonest cause. When the result of a blow on the forehead or temple, ecchymosis invades the lids at the external canthus. From either of these causes "black eye" follows quickly. After an injury to the head, if effusion appears gradually commencing in the orbit and beneath the ocular conjunctiva, it is considered by some as positive proof of fracture involving the orbital walls or base of the skull. Ecchymosis seldom occurs spontaneously, although it may in aged persons with weakened vessels, or a violent strain, may cause it.

*Treatment.*—Cold applications. Tincture arnica has been employed. A solution of ammonii chloridum  $\bar{3}$ ss. to water  $\bar{3}$ xvj has given good results in some cases. Internally the use of pulsatilla has been claimed to hasten absorption. The use of leeches and local blood letting is to be condemned.

**EMPHYSEMA.**—This condition is occasioned by air in the cellular tissues, usually produced by communication between the subcutaneous tissue and neighboring air cavities through fracture of the orbital bones. Fractures of the frontal bones,

or of the base of the skull involving the sphenoidal or ethmoidal sinus may produce this result. Usually emphysema is the result of external violence, but may occur as the result of an opening in the bone by disease, forced expiratory effort forcing the air into the tissues. Tracheotomy or stab wounds of the chest have been followed by emphysema of the neck and face as well as the lids.

*Treatment.*—Compression and avoidance of forced expiratory efforts and blowing the nose will be found the most satisfactory.

**ABSCESS OF THE LIDS (phlegmon).**—Generally the result of contusion, although it may result from disease of the orbit. Badly nourished children may be victims of this disease. The entire lid is hyperemic, the conjunctiva injected and frequently edematous. The appearance in many cases resembles erysipelas, but a localized, red elevation can soon be detected, which increases in size and finally softens at the center. The entire upper lid may be involved. If the abscess is located over the lachrymal sac it may be mistaken for dacryocystitis. There is usually considerable pain, headache and fever.

*Treatment.*—In the early stages, aconite. If there is much burning pain, *Rhus tox.* Lime in some form, either lime water or sulphide of calcium should be given. Locally, if seen early, the use of iced cloths, changing them every fifteen seconds, keeping this up for five minutes at a time, will sometimes abort the condition. If softening of the mass is felt, a free incision, parallel with the lid, should be made, and the contents evacuated. Use the boric acid wash frequently to keep the surfaces clean. If there is much conjunctival irritation the use of the morphine and hydrastis collyrium will be found beneficial.

**FURUNCLE.**—A localized inflammation of the skin and subcutaneous tissue. The symptoms are similar to those of abscess, but forms a central slough.

*Treatment.*—Similar to that of abscess, only avoid the cold applications. Hot applications are more generally useful in

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this condition, but care must be exercised to avoid general poultice effect, as it may do damage to the eye itself.

**HORDEOLUM (style).**—A small furuncle or boil occurring about a hair follicle on the lid margin. The swelling is circumscribed, tender, and situated on the anterior edge of the lid. The redness and swelling may extend over the entire surface of the lid. There is no involvement of the Meibomian glands. The pain is usually severe on account of the close structure of the tarsus and sensitiveness of the lid margin. In some instances the contents do not break down in pus, and absorption does not occur, thus forming "blind styes," which are essentially chronic in form. Some persons are subject to a mild form of this disease, in which superficial pustules appear on the lid margin. Recurrence of the disease is characteristic as styes generally come in crops.

*Causes.*—Errors of refraction are often the cause. Exposure to heat, dust, or irritating vapors, debilitated condition of the system, constipation and menstrual irregularities may also be classed as causes.

*Treatment.*—The use of a saturated solution of boric acid has seemed to abort the pests at times. If seen early, epilation of the lashes at the point of swelling will often abort the sty. If pus has formed, an incision into the tumor and evacuation of the contents is the only procedure. The incision should be made parallel to the edge of the lid. Internally the use of lime-water or sulphide of calcium will often prevent a series of styes. Refractive errors, if present, should be corrected.

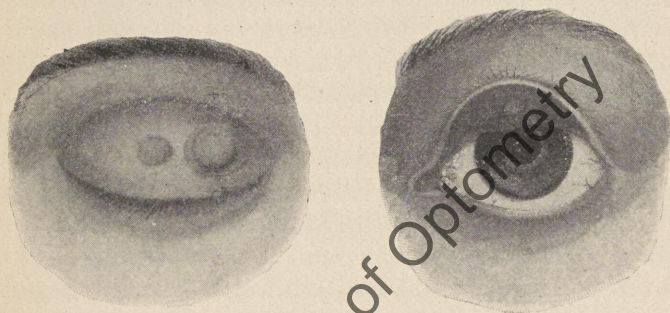
**TARSITIS.**—Inflammation of the tarsus seldom occurs as an independent affection. On account of the close connection of the tarsus with the conjunctiva however, it is very likely to be implicated in inflammatory conditions of the latter membrane, especially the chronic form.

The atrophy and distortion of the tarsus in connection with cicatricial contraction of the conjunctiva after trachoma is an important factor in entropion. Deep inflammation of

the skin, especially of the erysipelatous form, may also extend to the tarsus.

Inflammation occurring in the tarsus is nearly always syphilitic. The progress is slow, the swelling often considerable and hard to the touch. The skin however is freely movable over the tarsus. If changes in the form of the tarsus occurs, operative measures will often be required.

*Treatment.*—If specific, the patient should be placed on iodide of potassium, and as there will usually be found enlargement of the lymphatics, phytolacca in combination with iris versicolor should be used when there is inactivity of the glandular structures. Red iodide of mercury, 1-100 grain doses, should be given in the secondary stage of syphilis. Iodide of arsenic, 1-200 to 1-100 grain doses, especially if a scrofulous condition complicates the syphilitic. The usual specific treatment should be followed in these cases.



FIGS. 11, 12.—Chalazion, outer surface and appearance with lid everted.

**CHALAZION** (Meibomian Cyst, Tarsal Tumor).—This is a chronic disease of the Meibomian glands, and has for its site the tarsus. The tumor is tense, rounded and firmly adherent to the tarsus, but the skin is freely movable over the mass. As a rule there is little, if any inflammatory action, and the tumor slowly increases in size until more or less disfigurement occurs through the skin bulging forward.



According to Horner, chalazion is analogous to acne rosacea of the skin, in the latter the sebaceous glands being involved, while in the former the Meibomian glands are affected. The contents of the cyst are gelatinous in the early stages, but later may become purulent, although this is denied by some.

Under ordinary circumstances the growth tends toward the conjunctival surface, and on eversion of the lid there will be seen a bluish discoloration which marks the site of the tumor. If the contents are purulent, the color will be yellowish. Rarely in the early stages the tumor may disappear spontaneously. The morbid condition may be single, but often is multiple.

If not removed, inflammatory adhesions with the conjunctiva may form, especially if the lid is irritated through extraneous causes. If the mass breaks down there will be an escape of the contents, and granulations may project through the fistulous opening. In rare cases the skin may also become adherent. Occasionally the sac will rupture, and the purulent material burrow under the tissues of the lids, resulting in considerable deformity.

*Causes.*—Not definitely known, although there seems to be some definite relation between eye-strain and chalazion. Chronic blepharitis, or a debilitated condition of the system, also seems to favor this condition. It is seldom seen in children or young persons, although it does sometimes occur before middle life.

*Treatment.*—If seen early, during the forming stage, massage will sometimes cause them to disappear, though no definite promise should be made. The treatment should be made once or twice a day, but the manipulation should not be so severe as to cause excessive irritation of the eyeball. When the growth is of considerable size, or of long standing, an operation is the only measure of relief.

If possible the incision should always be made on the under surface of the lid, directly over the tumor. I prefer a

crucial incision. The contents should be evacuated, bringing the sac also, if possible. Pressure with the thumb nails will ordinarily be all that is necessary for the purpose. If the sac is not removed, it should be broken down with a chalazion scoop or curette. A probe may also be used for the purpose. The cavity will be filled with blood, but this will be absorbed in a week or two. There always remains considerable thickening of the surrounding tissues after the removal of the tumor, and it must be explained to the patient, else he will think the growth has not been removed. This swelling usually disappears about the time the blood is absorbed.

If it is necessary to make the incision through the skin, instead of the under surface of the lid, the incision should be parallel with the fibers of the orbicularis muscle, so as to leave as little scar as possible. The same method of procedure should be observed in this as in the first method.

If the chalazion is near the lachrymal sac or puncta, especial care must be exercised not to injure the structures, as greater inconvenience will be caused the patient than by the original disease.

It is generally better to do this operation under ether or chloroform, as the pain is considerable, and the work can be done with more ease by having the patient tractable.

**BLEPHARITIS MARGINALIS** (Blepharo-Adenitis; Ophthalmia Tarsi).—This inflammation of the lid border may involve the skin, conjunctiva, cartilage, and sebaceous glands, and when it extends deeply, the bulbs of the cilia and Meibomian glands. It varies from a simple hyperemia to a serious disease of the tissues and ultimate destruction of the cilia, eversion of the lid margin, and obliteration of the lachrymal punctum.

Hyperemia of the lid margin is often chronic and obstinate. The edge of the lid is reddened and slightly swollen, and there is some increase of secretion of the sebaceous glands. The eye is sensitive to bright light, cold, wind, or dust, and is



irritated by close work. The claim is made that it is more prevalent among blondes. A strumous diathesis is a common factor. Over-indulgence in eating or drinking, and uterine derangements are also given as causes. The majority of cases, however, result from eye-strain, as when this condition is remedied a cure follows without any treatment in many instances.

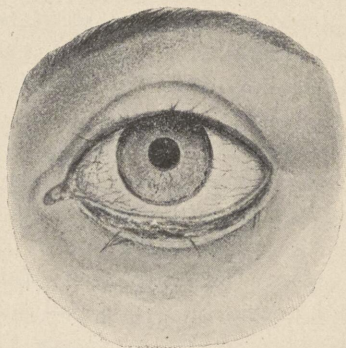


FIG. 13.—Blepharitis.

The amount of secretion varies as well as the amount of swelling of the lid margins. If there is a complete loss of cilia the condition is called "*madrosia*". When the lid margin is much thickened, rounded, and everted, with a smooth cicatricial surface on which the orifices of the follicles, glanducts, and canaliculus are lost, the term "*Lippitudo*" is given.

*Treatment.*—If a refractive error is present, it should be corrected, as otherwise treatment will only be palliative. Removal of crusts or scales from the lid margin is imperative. The edges of the lids should be anointed at night with an ointment of boric acid or plain vaseline; this will soften the crusts and render their removal easier. The use of warm water in which common baking soda (bicarbonate of sodium) is dissolved, a teaspoonful to a pint of water, and placing cloths or absorbent cotton saturated with this over the lids

will remove the crusts as a rule without much irritation. Care must be observed not to irritate the eye in these cases, as the congestion is increased by so doing. In severe cases it is sometimes necessary to raise the crusts with a blunt probe. After the removal of the crusts, any dead lashes should be removed, as they are a constant source of irritation. The application of the boric acid ointment should be continued until the acute stages have subsided, then the use of an ointment of yellow oxide of mercury may be found desirable. The strength of the ointment is from gr. ss. to gr. ij. to 3j. of the base. Care in preparing the ointment must be taken to prevent any "lumps" occurring, as they will be extremely irritating. The mercury should be first rubbed with a few drops of glycerine before adding the base.

If there are deep ulcers along the lid margin, or if there is a tendency to bleed when the crusts are removed, these points should be touched with a crayon of nitrate of silver, care being exercised not to touch the globe.

The nasal passages should be carefully examined and any complications in this region be remedied. If there is any obstruction of the lachrymal drainage apparatus, it must be relieved.

Internally the use of iodide of arsenic gr. i-200-i-100 in scrofulous persons, with an anæmic condition. Liquor potassii arsenitis in those cases having profuse watery excoriating secretion of tears. Calcium with tendency to pus formation. Phytolacca with enlarged lymphatics. Rhus tox. when there is a burning sensation, and motion of the lids and eyeball seems to afford relief. Apis with a stinging sensation and edema of lids, scanty urine. If there is much edema of the lids apocynum will be indicated.

PHTHIRIASIS CILIORUM is an affection of the lids which presents a clinical picture resembling blepharitis, and is the result of pediculi pubis among the lashes. Most likely to be seen among the so-called lower classes.



*Treatment.*—Unguentum hydrargyri or liquor potassii arsenitis locally.

HERPES ZOSTER OPHTHALMICUS.—This appears to be the result of disease of the branches of the fifth nerve, or of the Gasserian ganglion. One or all of the ophthalmic branches may be implicated, and over these branches will be an eruption of vesicles, situated upon inflamed bases. Neuralgic pain, heat, and redness of the skin precede the eruption, which may vary from a pin head to a split pea in size. The vesicles may be distinct or may coalesce in irregular patches. The contents of the vesicles at first is a clear yellow fluid, later becoming turbid. After a week or ten days they dry up and the brown scales drop off, leaving marked and often disfiguring scars. The disease may be mistaken for erysipelas, but the acute neuralgic pain and formation of vesicles distinguish it. Partial or complete anesthesia of the skin affected may continue for a long period after the subsidence of the disease. There may be implication of the conjunctiva, cornea, or iris, and cases have been reported of paralysis of the ocular muscles,

The disease seems to be more prevalent among elderly persons of feeble nutrition, although it may occur at any age.

*Treatment.*—Local measures have little or no effect. Internally the use of arsenic will sometimes afford relief. Rhus will sometimes also give relief, but as a rule the disease will run its course irrespective of treatment.

TRICHIASIS—Distichiasis.—The distinction between these two conditions is of slight importance. In trichiasis the lashes turn inward against the eyeball; distichiasis means the condition in which there is an additional row of lashes, the posterior being supernumerary, and these turning in against the eyeball. There may also be some incurving of the lid margin in this condition. In either case the lashes become a source of irritation instead of protection.

*Causes.*—Usually the result of inflammatory conditions of the lid margins, chronic in character, or it may result from diseases of the conjunctiva or tarsus. The lid margin is usually thickened, and the posterior free edge loses its definite outline.

*Treatment.*—Epilation, if the abnormal lashes are not too numerous, repeating as required ; this may cause atrophy of the hair bulbs and effect a cure. Destruction of the follicles may be done by galvano-puncture, but if the lashes are numerous this is not advisable as damage may be done if care is not exercised. In many cases operative measures alone will suffice. (See operations.)

**ENTROPION.**—This is an inversion of the free margin of the lids, turning the lashes against the eyeball. Trichiasis is a frequent complication of entropion. Entropion may be divided into two forms—spasmodic and cicatricial or organic. In the spasmodic form there may be no abnormal condition of the tarsus, and the lid margins may be healthy, but incurving of the margin results from spasmodic contraction of the orbicularis at the ciliary border. This condition is more likely to be found in the lower lid, and results from a lax condition of the skin. It is sometimes found also in cases of irritation from a foreign body or keratitis. The second form is the result of organic changes in the conjunctiva or tarsus, resulting from cicatricial changes following trachoma, diphtheritic conjunctivitis, burns, wounds, etc.

*Treatment.*—In the spasmodic form, if the result of irritating conditions, the removal of the cause will allow the lids to return to the normal position, but if the tissues are very lax, painting the skin with flexible collodion, or the application of adhesive strips may hasten the cure. In the organic form operative measures alone will prove of benefit. (Operations.)

**ECTROPION.**—Turning of the margin of the lid outward, exposing the conjunctival surface more or less. Two types are recognized, the acute or spasmodic and the cicatricial.



The former may result from swelling of the conjunctiva and spasm of the orbicularis. Keratitis may also be an exciting cause. In the latter form it is an organic condition and may be caused by lacerated wounds of the lids, burns, ulcerative diseases of the lids—in fact anything that results in cicatricial contraction.

*Treatment.*—In spasmodic ectropion the removal of the cause will usually be all that is necessary, but in some cases a compression bandage may have to be applied for a short time. Operative measures will be required in the organic forms.



FIG. 14.—Ankyloblepharon.—*Hansell and Bell.*

**ANKYLOBLEPHARON.**—Adhesion of the lid margins more or less complete. This condition may be congenital or acquired. The acquired form may be produced by any cause which denudes the normal covering, as burns. The acquired condition is not often seen, if extensive, without symblepharon as a complication.

*Treatment.*—If not extensive, pass a grooved director behind the adhesion and divide it. If extensive, however, a plastic operation may be necessary.

**SYMBLEPHARON.**—Adhesion of the lids and eyeball, more or less complete, usually of the lower lid, though I had one case in which both lids were attached to the ball as the result of some one doing a faulty operation for pterygium. The most frequent causes of this condition are burns, destroying the conjunctival epithelium. Lime, acids, caustic soda or potash, powder, molten metal, etc., and sometimes the more

severe forms of conjunctivitis. The bands of adhesion may be slight or extensive. The cornea is often involved.

*Treatment.*—If seen early, before adhesion takes place, the formation of the bands can often be avoided by keeping the lid away from the traumatism, pulling it away every hour or so. Sometimes the application of a mild ointment will be an aid in preventing adhesion.

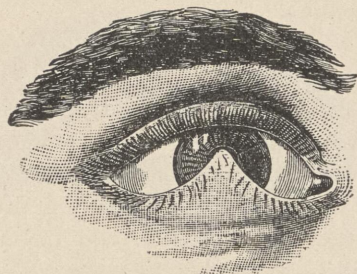


FIG. 15.—Symblepharon.—Norton.

The placing of a pledget of cotton, which has been covered with an unirritating ointment will also be an aid in these cases. If the burn or traumatism extends well back into the posterior fornix, the method of transplantation of some of the ocular conjunctiva, so as to bring healthy epithelium in contact with the raw surface on the lid, will be necessary.

**FISSURE OF THE CANTHUS.**—This is a not uncommon complication in conjunctivitis and keratitis, especially when there is considerable photophobia and spasm of the orbicularis muscle. The groove formed at the outer canthus by this spasm becomes excoriated by the discharge from the eye, and superficial ulceration results. Through reflex irritation the spasm is increased, and further complicates the condition.

*Treatment.*—The application of the salicylic acid ointment, or eucalyptus ointment will heal the surface, and relieves the spasm, but in aggravated cases a canthotomy or canthoplastic operation may be required. Care must be exercised



not to get any of the ointment into the eye, as the irritation will be excessive. The application of compound stearate of zinc with salicylic acid (mild) will also be found beneficial.

**BLEPHAROSPASM** — This is a symptom of reflex disturbance, and may be due to a variety of causes. All grades are found, from slight twitching of a few fibers of the orbicularis muscle in the lower lid, to complete closure of the lids. It may be either a clonic or a tonic spasm.

The former, which is the mildest form, is generally the result of refractive errors, over use of the eyes, or some deficiency of the ocular muscles. In children, excessive winking, with more or less jerking of the facial muscles, has been designated by Weir Mitchell as "habit chorea." Blepharitis, follicular conjunctivitis, reflex irritation of the fifth nerve through the influence of foreign bodies in the eye, iritis, cyclitis, and phlyctenular disease may be causes. Sometimes results from hysterical conditions.

The tonic variety is where there is complete closure of the lids, and may be produced by the same causes, only the symptoms are aggravated. Carious teeth and nasal affections may also be a cause of either form.

*Treatment.*—If due to refractive errors, this should be corrected. If muscular imbalance is found, this should be overcome if possible. If foreign bodies are the cause, their removal will be all that will be required. Conjunctival or corneal diseases should be treated independently of the spasm. If the twitching is slight, only a few fibers being affected, the local application of aconite and veratrum, aa. fl. ʒij; aqua, fl. ʒiij. Mix. Apply over the affected parts.

Internally, if the result of eye-strain, jaborandi, gtt. i-ij, will often give relief. Ignatia in cases of uterine disturbances. Pulsatilla when apprehension exists. Nux when disturbance of the alimentary tract is present.

*Prognosis.*—Drooping, either partial or complete, of the upper lid over the eyeball, with inability to voluntarily raise

the lid. This condition may be congenital or acquired. The congenital form may result from an excess of the integument of the lid. Defective development of the levator muscle may be a cause. Paralysis, probably the result of injury from excessive pressure upon the cranium during parturition, is given as a cause. An excessive accumulation of fat in the connective tissue is also a cause.



FIG. 16.—Ptosis.—*Hansell and Bell.*

The acquired form is nearly always the result of paralysis either central or peripheral, and usually is associated with paralysis of some of the orbital muscles supplied by the third nerve. It may be hysterical.

Syphilis and rheumatism are important factors in this disease, and if the case is one that will yield to remedial measures, can be cured by proper medication.

Diphtheria is also a cause, but as a rule the drooping is transient, passing off as the system regains its normal tone.

*Treatment.*—If the result of syphilis, the use of iodide of potassium combined with chloolacca if there is enlargement of the lymphatics, will be the best treatment. The use of red iodide of mercury in 1-100 grain doses will be of benefit in many cases, also thus will be found useful in rheumatic cases, especially if there is a burning sensation in the lids and motion (winking) gives relief. Bryonia will be better when closure of the lids affords relief. Salicylic acid from oil of wintergreen, combined with a soda salt, may be useful in some rheumatic forms, but the use of the drug is



largely empirical. Prof. Scudder recommended the drug in those cases where the tongue was full, purplish, or leaden-colored, and where the rheumatic area exhibited local redness. Jaborandi has given relief in some cases, and especially those in which there seems to be a lack of mucous secretion. In diphtheritic ptosis, the administration of dilute phosphoric acid and nux vomica will be found to hasten recovery.

In many forms operative measures alone will prove effective. (See operations.)

INJURIES OF THE EYELIDS.—These may be incised, lacerated, or contused wounds, burns and scalds. Emphysema, ecchymosis and edema are the usual results of injuries, especially contused. A careful examination should always be made to discover whether any lesions of the orbit or eyeball complicates the external injury. After cleansing a lacerated or incised wound, the edges should be approximated carefully, and if possible avoid sutures, holding the parts in apposition by means of a few cotton fibers and flexible collodion. If sutures must be employed, they should be very fine, so that as little scar is left as possible. A cold compress can be used, but as a rule a dry dressing will be more agreeable.

Burns and scalds must be carefully handled to prevent the adhesion of the lids (ankyloblepharon), by frequently separating them. A mild ointment may be used to keep the edges of the lids from adhering. The use of a five per cent. ointment of aristol is a favorite for burns, especially of the skin.

MOLLUSCUM FIBROSUM (Cutaneous Corns).—Sometimes seen, and there may be similar growths elsewhere on the body. The growths may be pedunculated or sessile; they can usually be removed with the saturated solution of salicylic acid in thuja, but if this fails excision should be practiced.

NEUROMA—Lipoma.—Either of these tumors may be found in the lids; they are benign in character and should be carefully dissected from their situation. A lipoma may increase to such a size as to render it impossible to voluntarily raise the upper lid. In a case of this kind removal of the mass is not always followed by normal elevation of the lid, so a guarded statement of the result of the operation should be given.

A growth very seldom seen is adenoma of the Meibomian glands.

Enchondroma of the tarsus is another growth which rarely occurs; both forms are benign in character.

XANTHOMA—(Xanthelasma).—Fatty degeneration and new connective tissue growth occurring in the eyelids, usually the upper, most likely to occur in elderly persons. There is a slightly raised area, more or less oval in form, yellowish or straw-colored and with a smooth surface.

*Treatment.*—Removal of the affected tissue when this can be done without producing deformity of the lid.

SARCOMA.—Sarcoma may occur as a primary growth. It is most frequently seen in children. The origin may be in a Meibomian gland, the connective tissue, or the conjunctiva of the lid; in the latter condition the tumor is frequently pedunculated. In the early stages the skin is freely movable over the growth. The sensation given on palpation is that of a roundish mass more or less elastic. In this stage there is a chance of mistaking the growth for a chalazion, but the growth is much more rapid than the latter. Ulceration may follow, and the orbital tissues may be implicated.

Extirpation may be followed by recurrence, so an early diagnosis is most favorable, if complete removal of the growth has been performed. This may not be permanently curative, but nevertheless is always advisable.

INCREASED ACTIVITY OF THE MEIBOMIAN GLANDS.—When this condition occurs there will be crusts, small abscesses or calcarious accumulations on the lid margins, or



conjunctival surface. There is a yellowish appearance of the points, and they are readily removed with an eye needle, or point of a fine knife.

**ELEPHANTIASIS.**—This condition consists of an excessive growth of the skin and connective tissue, but is seldom seen. It may result from an injury.

**LEPRA.**—Leprosy may attack the eyelids, but is usually secondary to the same condition existing elsewhere on the face. Anesthetic colored areas, differing but slightly from the normal integument are found. Eventually, malformation of the lids is very sure to occur.

**LAGOPHTHALMUS.**—Imperfect closure of the lids. This may result from either paralysis, orbital tumors, anterior staphyloma, exophthalmic goitre, or it may be a congenital defect. It is most frequently found in connection with paralysis of other facial muscles.

*Prognosis.*—Guarded. Ulceration of the cornea may result through inability to close the lids.

*Treatment.*—In all forms, unless relief can be obtained before the integrity of the cornea is threatened, tarsorrhaphy will be imperative. If medical methods will afford relief without this operation, it of course should not be performed. The location of the lesion and its cause should be decided upon if possible and treatment regulated accordingly.

**BLEPHAROPHIMOSIS.**—A diminution in the length of the palpebral opening either through cicatricial contraction of the lids or adhesion of the lid margins at the external canthus, usually the result of excoriation of the surfaces through traumatism, inflammation, or ulceration.

*Treatment.*—If possible prevent adhesions from forming, but an operation is often required to remedy the defect.

**CHROMIDROSIS.**—A change in the character and color of the secretion from the sweat glands, or sebaceous glands. The color is bluish or bluish-black, and is usually located on the lower lid. Seen most often in women, especially hyster-

ical subjects. In many instances the condition is due to fraud, the patient using some substance to produce the discoloration. In true chromidrosis the morbid process may last for months. The discoloration may be readily removed by using an oily preparation and wiping with a soft cloth.

*Treatment.*—Constitutional measures which will restore the system to the normal should be employed. Locally the ointment of salicylic acid may be found beneficial.

POLIOSIS OR CANITIES.—Lack of pigment in the cilia. The cilia of both lids may be affected, or only part of them, and in some cases but one lid shows this peculiarity. The eyebrows also may be similarly affected; it may be a congenital defect, or result from an injury.



## CHAPTER III.

### LACHRYMAL APPARATUS.

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The lachrymal apparatus is divisible into two parts: the one, consisting of the lachrymal gland and its ducts, has to do with the secretion of the tears and their carriage to the conjunctival sac; the other, comprising the puncta, canaliculi, lachrymal sac, and nasal duct, is the drainage apparatus, and its function is to carry away the tears after they have performed their offices of moistening and washing away particles of foreign material from the conjunctiva and cornea.

ANATOMY. — The lachrymal gland is divided into two portions, the larger or superior portion is lodged in a depression at the outer angle of the orbit, the fossa glandulæ lachrymalis, just inside the orbital margin. The shape is similar to that of a small almond, and the upper convex surface is in contact with the periosteum of the orbital roof, attached by fibrous bands. The concave surface rests upon the eyeball, at the upper and outer portion, and the external and superior recti muscles. Separated from the larger portion by a fibrous band or septum, is the inferior or accessory lachrymal gland, which lies along the excretory ducts of the superior portion just beneath the mucous membrane of the fornix. The structure and general appearance of the gland resembles the serous salivary glands. The ducts which carry the tears from the two portions of the glands vary in number from six to twelve, the greater number being in the superior portion.

Psychical stimulation or irritation of the eye through any cause, will cause hypersecretion of tears, and it may result in an overflow on to the cheek, or the quantity may simply cause the frequent blowing of the nose necessary. The secretion from the glands is faintly alkaline, containing sodii chloridum, alkaline and earthy phosphates, fats, albumin, extractive matter and epithelium.

The drainage portion commences with the minute orifices (puncta lachrymalia), situated at the top of the small conical elevations (lachrymal papillæ), seen on the margin of the lids near the inner canthus. These papillæ are turned toward the eyeball in such a manner as to receive the tears as they flow toward the nose. These elevations are called upper and lower, the puncta being designated in the same manner. The puncta are the openings of the little canals (canaliculi lachrymales), which run from this point to the lachrymal sac. The direction of these minute canals is first vertical, then turn abruptly and pass almost horizontally to the lachrymal sac. The upper is the shorter of the two. The canals are situated just beneath the surface of the free border of the lids. Occasionally the two canaliculi unite and form one common duct before entering the sac.

The lachrymal sac is the upper dilated end of the nasal duct, and lies in a groove formed by the lachrymal bone and nasal process of the superior maxillary. The sac is composed of a fibrous, elastic coat, lined with mucous membrane, which is continuous through the lachrymal canals, with the mucous lining of the conjunctiva, and through the nasal duct with the pituitary membrane of the nose. The shape of the sac is ovoid, its upper extremity being closed and rounded, while the lower is continuous with the nasal duct. The internal palpebral ligament passes across and is closely connected with the anterior wall.

The lachrymal or nasal duct extends from the lower portion of the sac to the inferior meatus of the nose. The length of the duct is about three quarters of an inch. The





and at certain points are valve-like folds. Cylindrical epithelium lines the duct and sac.

The size of the bony canal which contains the membranous duct, varies in size and shape, the variations existing in different parts of the canal.

Diseases of the secretory portion of the lachrymal apparatus are infrequent, compared with the excretory part.

**DACRYOADENITIS.**—A comparatively rare disease, and consists of inflammation of the glands. It may be acute or chronic, suppurative or non-suppurative. In the acute form there is considerable swelling and redness of the upper lid at the outer angle. The swelling may be sufficient to cause the eyeball to be displaced downward and inward. Pain is severe and increased by pressure. Inflammation of the conjunctiva and sometimes chemosis. Resolution may take place, or a chronic form may result, and in some cases suppuration ensues. In the chronic form the symptoms are somewhat less severe, but considerable swelling remains, and the gland can be felt on palpation, the lobulated border being prominent. If suppuration follows, it usually points upon the skin, although the opening may be through the conjunctiva. The non-suppurative form has been called mumps of the lachrymal gland (Hirschberg).

*Causes.*—Injuries are probably the most common cause. Conjunctival and corneal diseases may be factors. Scrofulous subjects also seem to be more subject than others to this disease. It is generally only on one side.

*Treatment.*—If the diagnosis is made in the early stages, the use of aconite and phytolacca may cause reduction of the gland, phytolacca having the same effect on the lachrymal gland as on other glandular structures. Calcium should not be forgotten, either in the form of lime-water or the sulphide. Iris versicolor may be the indicated remedy. Locally, in the early stages, iced cloths may be useful; as a rule hot applications are to be avoided, as a poultice effect about the eye is seldom desirable. If suppuration occurs,



a free incision should be made on the conjunctival surface if possible, otherwise the incision should be parallel with the eyebrow and as close as possible to it.

**HYPERTROPHY OF THE LACHRYMAL GLAND.**—This is a rare affection, and although it has been observed at birth, it usually comes on in later years. The lobulated induration and slowness of growth, as well as the location at the upper and outer part of the orbit, confirms the diagnosis.

*Treatment.*—Phytolacca may have an influence on the structure, but as a rule operative measures only will suffice. (See operations.)

**PROLAPSE OF THE LACHRYMAL GLAND.**—This condition has occurred spontaneously, and is known by the tumor being soft and movable under the upper lid.

*Treatment.*—Operative.

**FISTULA OF THE LACHRYMAL GLAND.**—This may be the result of an abscess, or it may be a congenital defect.

*Treatment.*—Cauterizing the fistulous tract or a plastic operation may succeed. Extirpation of the gland may be necessary.

**SYPHILIS OF THE LACHRYMAL GLAND.**—Specific infection of the gland seldom occurs, but if it does the use of the iodides and phytolacca will usually effect a cure.

**DACRYOPS.**—Cystic distention of one or more of the efferent ducts. Eversion of the lids shows a bluish-pink, semi-transparent, elastic, somewhat fluctuating swelling, situated beneath the conjunctiva at its upper and outer part. The swelling increases suddenly through any cause that increases the activity of the gland. Unless the mouth of the duct is occluded, pressure over the tumor will cause partial or complete emptying of the cyst.

*Treatment.*—An artificial opening between the cyst and the conjunctiva may be made, the incision being kept open by probing for a time to prevent too rapid cicatrization. Von Graefes suggests passing a silk thread through the wall

of the cyst, tying in a loose loop, and permitting it to cut its way out.

**TUMORS OF THE LACHRYMAL GLAND.**—These may be fibroid, sarcomatous, adenomatous, hydatid cysts, etc., in fact any kind of tumors that may be found elsewhere.

*Treatment.*—Extirpation of the gland.

**ATROPHY OF THE LACHRYMAL GLAND.**—This condition has been seen in cases of xerosis of the conjunctiva. There is no treatment.

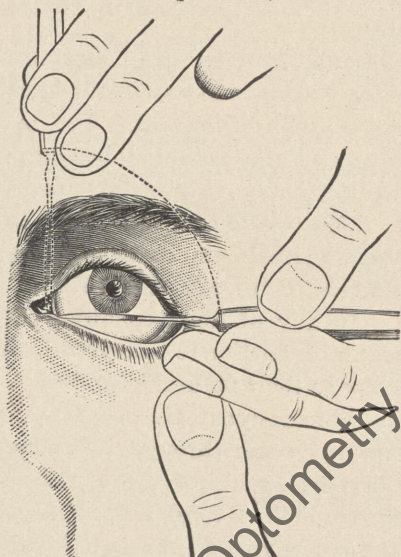
**ANOMALIES OF THE PUNCTA AND CANALICULI.**—(1) Congenital. Double puncta and canaliculi have been seen, as well as absence of both structures. The lachrymal points may be wanting, and the canaliculi be simply open canals, running along the edge of the lid, like small furrows. (2) Acquired. Malposition of the puncta through wounds of the lids, lupus, epithelioma, chronic inflammation of the lids or conjunctiva, ectropion, etc. Facial paralysis may be the cause. In any of these conditions the punctum becomes changed in its relation to the eyeball, and the tears are not carried away in their natural channels. The term epiphora is employed to designate the overflow of tears. Stenosis of the punctum may occur through inflammatory conditions of the lids, or obstruction of the canaliculus may occur through introduction of a foreign body as a cilium. The canaliculus may be narrowed through inflammatory action also, producing the same results as the foregoing conditions.

*Treatment.*—This will vary according to the cause and condition of the structures involved. If the obstruction is the result of mechanical causes, the removal of this condition will suffice. The puncta may be occluded, while the balance of the excretory apparatus remains intact; in such a case the opening of the puncta, usually by dilatation, will be sufficient. The triangular probe found in every pocket-case of instruments is as good an instrument as any for the purpose. Sometimes the canaliculus is narrowed, and must be dilated by means of a probe. Slitting of the canaliculus



should be avoided if possible, as then there is an open gutter instead of a capillary tube, and the danger of foreign bodies getting into the lachrymal sac and setting up severe inflammatory action is increased.

If slitting of the canaliculus is required, it should be done with a narrow-bladed, probe-pointed knife, which should be introduced into the puncta vertically, then bring the handle of the knife to a horizontal position, the handle towards the



**FIG. 18.**—Method of holding knife and lid. Dotted line represents the position of the knife when the operation is completed.—*Fox and Gould.*

outer canthus, keep the lid on the stretch with the disengaged hand, and push the knife inward until the point strikes the lachrymal bone, then bring the handle of the knife to the vertical position again, keeping the cutting edge towards the conjunctiva, and cutting the whole length of the canaliculus. The cut edges must be separated or they will heal together in a short time. Sometimes it is only necessary to slit for a short distance from the punctum, and dilate the

rest of the canal. This is preferable if it will answer the purpose.

Malpositions through inflammatory action will generally have to be remedied by some plastic operation.

**DACRYOCYSTITIS.**—This is a catarrhal inflammation of the lachrymal sac, and occurs both as an acute and chronic condition. Primary inflammation of the sac is of rare occurrence. In the vast majority of cases the disease is dependent upon disease of the nasal duct or the nasal tissues, the inflammatory action extending into this region. Injury of the nasal bones may cause the disease, or the introduction of irritating solutions into the sac, but either of these causes are rare.

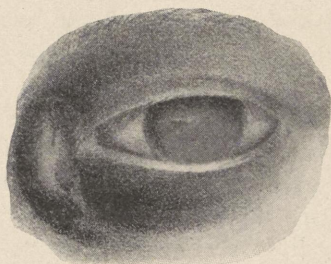


FIG. 19.—Acute Dacryocystitis

*Symptoms.*—The eyes “swim” in tears, and exposure to high winds, dust, or irritating vapors, will cause them to overflow. The conjunctiva becomes hyperemic and injected, the margin of the lids, especially near the inner canthus are reddened, blepharitis being the result.

Frequently there is swelling over the sac (mucocele, lachrymal tumor). Pressure over this swelling will express some of the retained fluid through the puncta. The fluid may be clear, or a semi-transparent viscid mucus (dacryocystitis catarrhalis), or morbid from the presence of purulent material (dacryocystitis blennorrhoea).

In the chronic form there is seldom pain, but when through



any cause the inflammatory action becomes acute, the swelling is considerable, redness of the tissues over the sac is marked, and the pain often intense. At this stage the disease may be mistaken for erysipelas, lupus, or some of the skin diseases affecting the skin of the face or lids. There is often a severe chill followed by fever.

If there is phlegmonous inflammation of the cellular tissue surrounding the sac (dacryocystitis phlegmonosa), the pus will burrow in front of the sac, forming pouches in the connective tissue, and usually the lachrymal abscess thus formed points below the tendo-oculi. If left alone, the abscess ruptures externally, usually leaving a fistulous opening into the sac. This fistulous opening may close after the acute symptoms subside, but often it is permanent.

*Diagnosis.*.—As a rule not difficult, although at times through association with other diseases, the diagnosis is complicated.

*Treatment.*.—The resort to radical measures should be left until other means fail. Gentle massage over the sac will often cause it to empty, then by using a wash of boric acid, some of the solution can be worked into the sac. The acute attacks, resulting from rhinitis, will show a thickened condition of the nasal tissues as a rule, and in such cases the prompt emptying of the sac can usually be effected by using a pledget of cotton, as large as can well be placed in the nostril, saturated with glycerine. This should be allowed to remain for twenty minutes or half an hour, then repeat the application. As a rule two applications will be all that are necessary, the contents of the sac being discharged through the nasal duct.

In cases of chronic dacryocystitis, the swollen turbinates are often the cause of the trouble, and in such, the use of an ointment of salicylic acid (gr. xx to ʒj) applied in a similar manner to the glycerine, will result in a cure in numerous cases. The internal administration of aconite in the acute stages must not be forgotten. Sulphide of calcium 1-100 gr.

is the best in purulent cases. Iodide of arsenic in 1-200-1-100 gr. doses in scrofulous cases. Iodide of potassium in syphilitic conditions.

If necessary to operate, the same precautions are necessary as advised in slitting the canaliculus. (See operations.)



## CHAPTER IV.

### DISEASES OF THE CONJUNCTIVA.

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Diseases of the mucous membrane covering the eyeball and under surface of the lids, comprises about thirty per cent. of eye affections. The conjunctiva is subject to all the pathological changes that mucous tissue in general is liable to, as well as some peculiar to itself. Being continuous with the mucous membrane of the nose, through the drainage portion of the lachrymal apparatus, it is especially liable to be affected by inflammatory conditions of the respiratory tract. The vascular connection being extensive, it is almost certain that inflammatory conditions affecting the anterior part of the eyeball, should affect the mucous membrane of the eye, as in keratitis, iritis and cyclitis. Inflammatory conditions of the posterior portion of the eyeball however seldom affect the conjunctiva, hence in diseases of the optic nerve, choroid, retina and vitreous we seldom find any pathological changes in this membrane.

In health the conjunctiva is quite transparent, the blood vessels not being noticeable, thus allowing the sclera to be clearly seen. In morbid conditions this is changed, and the transparent appearance disappears more or less completely, depending upon the intensity of the congestion. In simple hyperemia the membrane is more or less reddened by the increased vascularization. The blood vessels are distended and increased in number; the veins are more tortuous and larger, and in severe inflammatory action the

view of the sclera is entirely obliterated, the eye presenting a bloodshot appearance. An important diagnostic feature of conjunctivitis is the movable condition of the blood vessels over the ball when the eye-lid is moved by the finger or thumb against the globe. This is one of the points to remember in making a diagnosis between conjunctivitis, iritis episcleritis, &c.

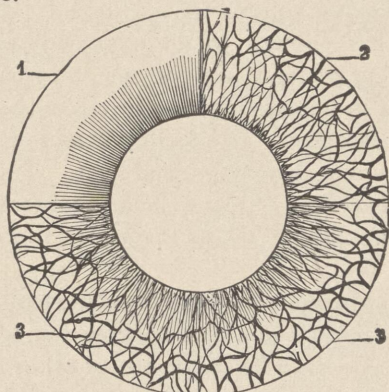


FIG. 20.—Conjunctival and Subconjunctival Injection. 1, Pericorneal zone; 2, Conjunctival injection; 3, 3, Sclerotic injection.—*Hansell and Bell.*

In the healthy eye the amount of secretion is only sufficient to keep the tissues moist, pliable and properly lubricated. In the various forms of conjunctivitis the amount of secretion is abnormal. In the hyperemic stages, the secretion is often deficient, causing a dry, stiff feeling of the tissues and lids. This stage is sometimes marked enough to give a dry appearance to the eye. The patient complains that it seems necessary to pull the lids open, especially in the morning. This is more frequently seen in the chronic form of hyperemia than it is in the acute. In the acute form the secretion is almost entirely watery, not enough mucus being present for lubricating purposes, and the membrane has a macerated look. In the second stage of inflammation, the mucus is increased beyond the normal through the increased activity of the glands.



Without a condition present favoring pus formation, the secretion preserves its mucous character, and catarrhal conjunctivitis presents. If from any cause pus is formed, pus cells are mingled with the mucus, and the color of the discharge changes, becoming more or less yellowish according to the amount of pus present. In the severer forms the pus predominates and may constitute nearly the entire secretion.

In uncomplicated conjunctivitis there is little pain, the tissues being lax enough to allow considerable distention without making pressure on the nerve terminals. When pain is present in uncomplicated conjunctivitis, it seldom is neuralgic in character. The feeling is more that of discomfort and annoyance, heaviness, and heat. The reflex symptoms of increased flow of tears (lachrymation) and dread of light (photophobia) are not as marked as in keratitis, iritis, cyclitis, &c.

During the hyperemic stages of the acute trouble, these conditions may be present in a slight degree, but soon subside; if they do not it is well to be suspicious of other lesions, and to make a careful inspection of the eye before it is too late.

For convenience, conjunctivitis is divided into three classes: hyperemic (and congestive), catarrhal, and purulent. The sub-divisions will be given under the appropriate headings.

**ACUTE HYPEREMIA (Dry Catarrh).**—This may exist independently, and is well represented in an eye in which a foreign body has lodged, either on the conjunctival surface of the ball or under the lids. Tobacco smoke, cold winds, irritating vapors, etc. may also cause this condition. Amblyopia is a prolific cause of this condition. Rhinitis, obstruction of the lachrymal canal, blepharitis, and some constitutional diseases may cause the condition, *e. g.*, gout.

In acute hyperemia the vascularity of the membrane is increased more by excessive determination of blood to the part than by obstructed return. The arterial circulation is known to be increased by the larger number of small, straight

vessels running toward the cornea, or point of irritation. Suffusion of the eye, due to increased lachrymation is usually present. There is seldom any discharge of mucus or pus in this stage, unless infection is introduced by a foreign body or other means. The amount of discomfort depends upon the cause and the individual. If the cornea is involved, neuralgic pain will often be present. A careful examination of the eyeball and lids should always be made, in order to eliminate foreign bodies as a factor.

*Symptoms.*—The congestion, sometimes a slight swelling of the conjunctival follicles, photophobia and lachrymation more or less marked, uncomfortable sensation in the eyes, increased by use of the eyes, especially by artificial light.

*Treatment.*—Removal of foreign body, if present. Correction of refractive errors. Due attention to nasal passages and general health.

Locally the use of the boric acid wash, using ʒij to a pint of water. If much irritation exists the use of: R—Morphine sulphate gr. ij, Lloyd's hydrastis flʒss, and aqua distillata q.s. flʒss, will be found soothing. The use of the active astringents seldom is beneficial, and a solution of nitrate of silver should never be used in these cases. The hot or cold water douches will be found useful in some cases. Any constitutional disturbance should be looked after.

CHRONIC HYPEREMIA (Passive congestion) of the conjunctiva.

The term hyperemia is really a misnomer, as a true condition is seldom found, it being more a passive congestion. In this disease there is not so much increased activity of the arterial circulation as there is a retarded and sluggish venous return. The veins are increased in size, more tortuous, and frequently very prominent on the conjunctival surface. This condition is more pronounced on the palpebral surface than on the ocular or bulbar. The ocular membrane in many cases is not affected, though it will redden more or less on slight provocation, more readily than healthy con-



conjunctiva. This is one of the most common of all conjunctival affections, and though not dangerous, is extremely annoying and uncomfortable. In many cases the use of the eyes for close work is impossible.

This condition is often a symptom of other eye affections and may be also due to general debility. Eye strain is a common factor, as well as disease of the lachrymal apparatus, nose, and vault of the pharynx.

*Symptoms.*—Heat, burning and itching of the eyes and lids, heaviness of the lids, and in bright artificial light, a disposition to partly close the lids. Not infrequently a feeling of dryness and stiffness, as though there was not sufficient moisture, especially at night when awakened from sleep. This is due to diminished secretion, and is sometimes designated as dry catarrh. The sensation as if sand or dust was in the eyes is very common, and in many cases it will be almost impossible to convince the patient that no foreign body is present. The swollen condition of the veins is responsible for this condition, the veins being raised above the surface of the conjunctiva, act as foreign bodies. Any cause which increases the flow of blood to the head will aggravate the condition. If neglected, it will be but a short time before distinct pathological changes occur; the tissues becoming thickened, the papillary structures enlarged, producing what is called hypertrophied papillae. The normal smooth appearance of the palpebral surface is lost and looks as though fine meal or dust had been sprinkled over the conjunctiva. These points are usually much smaller than the granules seen in follicular conjunctivitis or trachoma.

*Treatment.*—Does not differ materially from the acute, unless of long standing. Correction of refractive errors, good hygienic conditions, and as little use of the eyes as possible. Sulphate of zinc may be used with the hydrastis solution in these cases, and an ointment of boric acid gr. viii to white vaseline 3j applied to the lids at night will often afford relief. If there is a burning sensation of the

lids, and motion gives relief, rhus tox. should be used. Bryonia in those cases having the sensation of stiffness of the lids, and rest or quiet giving relief. If a rheumatic tendency is present, cimicifuga will be beneficial.

**ACUTE CATARRHAL CONJUNCTIVITIS.**—This condition frequently follows an acute hyperemia, and may be the process of resolution of this condition. The increased secretion of the glands relieving the distended vessels, restores equilibrium of the circulation. Sometimes no cause can be assigned, although as a rule this is not the case. Diseases of the upper air passages, bronchial affections, skin diseases, the exanthemata, typhoid fever, and rheumatism, exposure to irritating vapors, tobacco smoke, dust, etc., as well as ametropia and the introduction of infectious material, may be causes. The popular term "pink eye" is often used, but as it means nothing, it should not be used. If much swelling of the tissues surrounding the eye occurs, especially in young girls, it is well to inquire as to the existence of a vaginal discharge, as this leucorrhœal condition through infection, will often be found to be the exciting cause. Acute catarrhal conjunctivitis seems at times to be epidemic, especially when "influenza" is prevalent. Another cause is the popular application of "cold tea" to the eye. This habit prevails in most localities and will occasionally develop a serious condition of the eye.

*Symptoms.*—In the first stage, the symptoms do not vary from those found in hyperemia, and may last from a few hours to two days, when the discharge becomes mucous or muco-purulent. The secretion, in running over the lids, may excoriate the skin. The lids stick together mornings, caused by drying of the secretion on the lashes. On pulling down the lower lid, flakes or a roll of mucus or muco-pus will be seen lying on the fornix. In severe cases small hemorrhages in the conjunctiva may occur.

The lid may be slightly swollen, and a sense of discomfort or heaviness noticed, though actual pain is seldom present.



When pain is present it is confined to the eye and does not radiate to the surrounding parts like the neuralgic pains of iritis. Photophobia may be present, but is not usually marked, unless the eye affection is a complication of measles, or the corneal tissues are affected by small superficial ulcers.

The intensity of the symptoms is in proportion to the severity of the inflammation. The secretion also varies in amount and quality, from a small proportion of mucus to what appears to be a true purulent discharge, varying during the different stages.

Vision may not be impaired, but in the graver forms, more or less disturbance of vision is to be looked for. The corneal epithelium may be affected through maceration, causing visual disturbances, or the same effect may result from adhesion of the secretion to the corneal surface. If the corneal epithelium is affected, the symptoms of the disease are aggravated. Under such a condition ulceration of the cornea may appear, either during the course of the disease or following it. The cornea should always be watched carefully in all cases of conjunctival disease, so that what in the start was only a simple condition may not become a serious one, threatening the integrity of the eye itself.

*Prognosis.*—Good, as with any kind of proper care the condition will soon subside.

*Treatment.*—Cleanliness is of the utmost importance in this as in all diseases of the eye. As a general direction it is well to state that poultices seldom if ever are required about the eye, as in the majority of cases, they do more harm than good. Good hygienic conditions are of the greatest importance, which of course includes plenty of fresh air.

The diet should be nutritious and easily assimilated and the bowels kept in good condition.

Locally the eye should be bathed every half hour or hour with clear water, or preferably a solution of boric acid (3ij to water ℥xvj), this may be used either hot or cold according to the relief afforded the patient. As a rule it is safe to be

governed by the patient, in this matter. To use the boric acid wash, the lids should be separated, and using an eye pipette or dropper, throw a pipette full of the solution over the eyeball, taking care to hold the point of the instrument close to the ball, as otherwise the impact of the stream will cause so much discomfort or pain that objections will be made to future applications. The solution may also be squeezed from a small pad of absorbent cotton. The eye should be well flushed each time, and the process should be repeated often enough to keep the eye free from secretion. At night the ointment of boric acid will be soothing, and also will prevent in a great measure the lids sticking together.

After the acute stage has passed off, a mild astringent wash should be used, and the sulphate of morphine and Lloyd's hydrastis with equal parts of distillate of hamamelis and solution of boric acid will generally be all that is necessary. Sulphate of zinc (gr. j to fl̄ssj) will sometimes give good results. Lloyd's ergot fl̄ss to solution of boric acid will often cause the congestion to disappear rapidly. This solution must be kept in a cool place as it soon ferments, and then should not be employed, as it will be an irritant.

Internally, during the acute stage, aconite. When much swelling of the lids occurs, with a stinging pain, especially with kidney disturbance, apis, in doses of gtt. 1-10 to 1-6. If there is much edema, apocynum will give relief quickly. Pain in the eyeball or lids, aggravated by motion, bryonia. When motion of the ball or lids gives relief from pain, rhus tox. If the tissues have a bruised feeling, or if rheumatism is present, cimicifuga. If an apprehensive condition is present, pulsatilla. In nervous persons, especially women, not apprehensive, ignatia. With a purulent discharge, especially if corneal ulceration is threatened, sulphide of calcium in 1-100 gr. doses. If the secretion is stringy and tenacious, bichromate of potassium in 1-100 gr. doses. If anemia is marked, iodide of arsenic in 1-200 gr. doses. If there is enlargement of the lymphatic glands, phytolacca.



**PURULENT CONJUNCTIVITIS.**—This destructive disease occurs in two forms, designated in the new-born as ophthalmia neonatorum, and in adults as gonorrheal conjunctivitis.

A large proportion of the blindness existing in the world is due to the former division, while the latter also furnishes its quota.

Ophthalmia neonatorum is a disease of the new-born, the cause of the affection being the introduction of infectious material into the eye of the child during its passage through the parturient canal, or inoculation from soiled cloths or hands after birth. It is an injustice to say that in every case of this disease the mother has, or has had gonorrhea, for an acrid vaginal secretion is often present about the time of parturition, which will produce the same line of symptoms as the gonorrheal infection. Careless bathing is at times also a factor.

The claim is made that the disease is more frequent in face presentations, and this may be true, as in the other cases the secretion is more liable to be swept away by the presenting parts. Whether there is any difference in the ratio between boys and girls is a question, though the claim is made that boys are more afflicted than girls.

*Symptoms.*—Redness of the eyes is usually noticed the second or third day after birth; the sooner after birth the more severe the attack and the greater the danger to the integrity of the eye. Both eyes are likely to be affected, though sometimes only one will suffer. The first symptom is the slight redness, and also a slight discharge in the corners, the inner containing the most. This is soon followed by swelling of the lids and conjunctiva, which in severe cases is very pronounced.

The pain is evidently severe, and the discharge profuse. The surface of the lids is hot to the touch, the color red or dusky red, and the skin tense. The upper lid overhangs the lower, and can be everted only with difficulty. The discharge, which at first was only slightly turbid, becomes yellow or yellowish-green pus, and the quantity is enormous.

Eversion of the lids the first two or three days will show a swollen, red, and velvety conjunctiva, and the ocular membrane will be injected. Easily detached flakes of lymph will be found on the mucous surfaces. Later the conjunctiva becomes roughened and of a dark red color, spots of ecchymosis may appear, or the surface is succulent and bleeds with the slightest manipulation of the lids. Marked swelling and infiltration of the ocular conjunctiva soon appear, forming a hard rim; at the bottom of the crater-like pit the cornea is seen. This condition endangers the integrity of the eye on account of the impeded nutrition of the cornea. The thick, creamy discharge increases, and either flows from beneath the overhanging upper lid, or is packed up in the conjunctival *cul-de-sac*.

The tenseness of the lids may now become lessened, and they can be readily everted. The conjunctiva may lie in folds and papilla-like elevations, and the discharge contain blood and serum. The disease if left alone gradually declines, and in from six to eight weeks the discharge nearly or entirely ceases. The patient, however, will probably have lost the eye entirely, or vision will be reduced to not much more than perception of light.

The relaxed palpebral conjunctiva is thickened and granular in appearance, like the granulation tissue surrounding wounds. The ocular tissue is also thickened, and cicatricial changes often remain.

The greatest danger is loss of vision through destruction of the corneal tissue, especially if haziness of the cornea occurs within a day or two after the onset of the disease. Small ulcers, usually oval, are formed near the sclero-corneal margin, and rapidly increase in size. The ulcers are often central, so all parts of the cornea must be watched. The ulcers may, in the early stages, be transparent, but cloudy infiltration is nearly always present. In mild cases of the disease the cornea may escape implication.

Changes in the cornea may result from one of two causes,



the pressure on the nutrient vessels in the surrounding tissues by the excessive swelling, cutting off nourishment, and also by direct infection from the discharge.

Ulceration of the cornea may result in one of two conditions: either it will heal without perforation, especially if the ulcer is superficial; or if deep, it may perforate the cornea and lead to the loss of the eye. If the perforation is small and central, the aqueous escapes, and the lens is pushed forward against the posterior surface of the cornea, closing the opening, which soon becomes filled with lymph. The aqueous collecting, and the opening closed, the lens returns to its proper position, but carries with it a little lymph attached to the anterior capsule, and forms a pyramidal cataract. If the perforation is near the periphery, especially below, adhesion of the iris results, and is often entangled in the opening, being fastened in either case by inflammatory exudation. If either of these conditions occur, there is a dense, white scar (adherent leucoma).

When the tissues are much weakened, so that the intra-ocular tension pushes them forward, an irregular bulging mass results, called anterior staphyloma. Extensive destruction of the corneal structures, with total prolapse of the iris, matting together of the parts by exudation and protrusion of the cicatrix, is called total anterior staphyloma.

Perforation of the cornea may be followed by such severe inflammatory action that the ciliary body and choroid may be implicated, and panophthalmitis result, causing rapid destruction of the eye. The inflammatory condition may not be so active, and a low grade of inflammation ensue which will be followed by shrinking of the tissues and atrophy of the ball.

Convalescence may apparently be progressing nicely, when all at once a dense opacity of the cornea may appear; this may clear, but ulceration may occur.

The appearance of the conjunctiva varies. It may be covered with an easily detached lymph or with a gray false

membrane. Occasionally a deep infiltration develops like that seen in diphtheria. Restlessness, fever and other constitutional conditions frequently present, and synovitis of the knee and wrist, similar to that found in adults suffering with gonorrhea, may develop. Remember that not all cases will develop the entire range of symptoms, but that some may be lacking.

*Diagnosis.*—The time of the onset, the secretion in the corners of the eye, as well as the reddened conjunctiva, should make it impossible to be mistaken. Careful attention to the eyes of the new-born should always be given, no matter what the station in life of the parents, as too much confidence in this regard has led to the loss of an eye when it could have been avoided.

*Prognosis.*—Always guarded, and the earlier the attack and more violent the inflammatory action, the more conservative.

*Treatment.*—Cleanliness is of the utmost importance, and as a wash there is nothing better than the solution of boric acid. The solution should be made by dissolving  $\frac{1}{2}$ ij of the acid in a pint of clean soft water; distilled water is better but can not always be obtained. The bathing of the eye is important, and should be repeated often enough to keep the eye clean and free from secretion. The child should be laid on its back, the body resting on the knees of the nurse, who also holds the little one's hands, the head resting between the knees of the physician, a towel being spread over the knees to prevent soiling of the clothing; then, with absorbent cotton moistened with the boric acid solution, carefully wash away the secretion from the lids. Use a fresh piece of cotton every time, and do not save cotton by dipping into the solution after any of the secretion has been wiped off. No force should be used in this work, as any injury to the cornea may be fatal to the eye. After the external surfaces are clean, separate the lids carefully, and get some of the solution over the eyeball. This can be done by squeezing the



solution from the cotton, or by the use of an eye-dropper, getting the point of the dropper close to the eye so the impact of the fluid will not produce pain.

The utmost care must be exercised not to injure the corneal surface, as it will almost surely lead to ulceration. If ulceration has already occurred, very slight pressure on the globe may cause collapse of the ball and an eye that might have been saved, lost through careless handling.

After the secretion has been washed away, the lids should be everted and the conjunctival surfaces brushed with a three or five per cent. solution of nitrate of silver. The solution should be allowed to remain a few moments and then neutralized with a solution of common salt. The applications can be made with a mop of cotton on a cotton carrier, thus insuring a clean brush every time. No force should be used in making the application, just touching the surfaces with the cotton. After waiting a few minutes the lids should be again everted, and any shreds of coagulated mucus carefully removed; then drop in the following: R.—Morphine sulph. gr. ij., Lloyd's hydrastis flʒss., sol. boric acid q.s. flʒss. M. Sig.—Two drops in the eyes every two hours after washing them with the boric acid wash.

Take some old, soft linen or muslin, cut into squares of about two inches, having three or four thicknesses; these are to be placed on a piece of ice, and there should be a sufficient number so they will always be applied cold. Apply one of the pads to the eye and change it for a fresh one at the end of fifteen seconds, keeping this up for fifteen minutes. This should be repeated every hour or two, depending upon the severity of the case, until the purulent secretion has ceased to form.

When severe corneal complications exist, the use of the iced cloths must be abandoned, as they will have a tendency to still further lower the vitality of the corneal structures; so in this condition the use of hot applications will be more efficacious, but care must be exercised that a poultice effect

is not obtained, for this will do more mischief than no applications. The hot cloths should not be used for over five minutes at a time and should be change as often as directed for the iced pads. Strong astringents should not be employed in these cases as they will do harm in many instances.

If the cornea becomes cloudy, with or without ulceration, the use of atropine often enough to keep the pupil dilated, must not be neglected, unless there is a tendency to perforation near the periphery, when eserine should be employed; but even in this condition the atropine should be used once or twice a day on account of danger from iritic complications.

Internally during the acute stages give aconite gtt. 1-10 every hour. In slight edema of the lids with scanty urine apis gtt. 1-30 to 1-15 with the aconite. If the edema is excessive, apocynum gtt.  $\frac{1}{2}$  to  $\frac{1}{6}$  every hour. If the secretion is tough and tenacious, bichromate of potassium in 1-100 gr. doses three or four times a day. Calcium either in the shape of the liquor or sulphide should always be given in these cases.

Eternal vigilance is the price of the eye in these cases, and the most scrupulous cleanliness must be observed.

*Prophylaxis.*—Not only the medical profession, but the world owes a great deal to Crede for his investigations of this disease and the methods recommended for the prevention of it.

The necessity for using every precaution to prevent infection of the eyes should be remembered. It is much better to prevent infection if possible than to wait until the commencement of the attack to treat the eyes. The method of Crede is advisable when there is positive knowledge of infection, or where there are strong suspicions of it. This is to instil a two per cent. solution of nitrate of silver into the eyes as soon as they have been washed; this will usually prevent an attack. A very safe method is for the physician to personally direct the washing of the baby's face and eyes. An ointment of boric acid and white vaseline should be thickly spread



over the lids, one or two applications of this ointment being sufficient, then wash the secretion and ointment off with a warm solution of boric acid, using a fresh piece of absorbent cotton each time. No force should be employed in this operation as the utmost gentleness should be observed in all manipulations about the eyes of the new-born. This procedure will not injure the eyes and is free from the objectionable irritation sometimes produced by the use of a solution of nitrate of silver in cases where it is not required. If there is no infection of the eyes the use of the latter preparation has done mischief, hence it is not advisable to use it excepting in those cases of undoubted gonorrheal discharge.

**GNORRHEAL CONJUNCTIVITIS**—*Gonorrheal Ophthalmia*.—As a rule it is not difficult to trace the origin of this disease. Purulent conjunctivitis is also found in cases where gonorrheal virus is not the factor, the leucorrheal discharge from some females producing similar inflammatory action. As a rule but one eye is primarily affected, in a right-handed person the right eye most frequently. Purulent conjunctivitis has also resulted from the religious use of poultices in a case of simple conjunctivitis.

*Symptoms*.—Usually in from twelve to twenty-four hours after inoculation, although it may be forty-eight hours, when the disease is not so severe, there will be the first indications of trouble. The general line of symptoms are similar to those described under ophthalmia neonatorum. The vitality of the cornea is nearly always impaired and the danger to the integrity of the eye must be borne in mind. The corneal complications may arise during the acute stages, or later when convalescence is seemingly established. The ulcers may be central or peripheral, and the danger of perforation is great. Sometimes the entire corneal structure will slough off in a comparatively short time. Opacities may occur independently of ulcerated points.

If perforation occurs, the same conditions may arise as already described on page 74, while diseases of the deeper

structures may develop independently of corneal lesions, defeating any possibility of obtaining good vision.

The disease reaches its climax in about ten days, then subsides gradually until in from one to two months it has become simply a chronic blenorrhea, unless the eyeball has been destroyed.

The inflammatory process is very severe and runs a rapid course. The lids and palpebral conjunctiva are as a rule excessively swollen and the purulent discharge is profuse. Arthritis is often an unwelcome complication about the time of the onset of the eye affection. The general line of symptoms are about the same as ophthalmia neonatorum.

*Treatment.*—Cleanliness must be insisted upon, and the boric acid wash again comes in play. If seen early the use of a five or ten per cent. solution of nitrate of silver will often be of advantage. The solution should be used after the secretion has been well washed from the eye, as directed on page 75.

Iced cloths should be used as already directed, unless corneal complications exist, when the use of hot applications should be substituted.

Free catharsis should be one of the initiatory steps of treatment, and the bowels should be made to move two or three times a day during the inflammatory stage.

Corneal complications must be watched for, and as soon as discovered the use of atropine to keep the pupil fully dilated should be insisted upon. At times when the ulceration is near the periphery, eschara will be required, but even then the atropine should be used at least once a day, as it will relieve ciliary congestion.

If perforation threatens it may be necessary to perform paracentesis through the floor of the ulcer. Sometimes the actual cautery is employed, but neither measure is safe except in the hands of one accustomed to handling the instruments. If perforation has taken place the excision of the prolapsed iris, as recommended by some, is not a safe meas-



ure, as infectious material may in this way find entrance to the chambers of the eye, and cause rapid destruction of the organ. The use of atropine if central, or eserine if peripheral, is much safer treatment.

The result of the disease will depend upon the extent of the corneal lesions; the remaining leucoma, staphyloma or shrunken ball, requiring iridectomy, abscission, eversion, or enucleation.

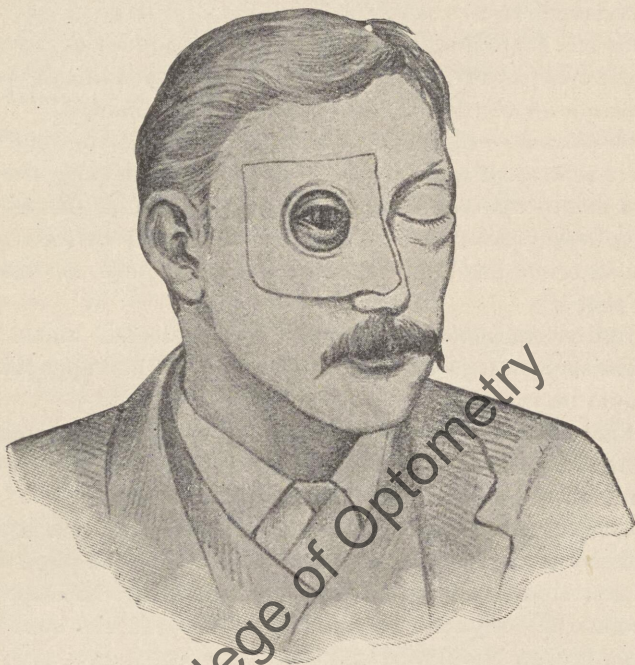


FIG. 11.—Buller's Shield.—Berry.

Locally the boric acid wash. Solution of permanganate of potassium (1:5000) a continuous irrigation until a pint is used, is recommended by some. Peroxide of hydrogen has also been recommended. The use of the hydrastis preparation however will prove most beneficial in the majority of cases.

Constitutional treatment is important. During the acute stage aconite gtt.  $\frac{1}{4}$  -  $\frac{1}{3}$  every hour. Apis gtt. 1-10-1-5 with stinging pain and edema with scanty urine. Apocynum gtt. ss-j with excessive edema. Sulphide of calcium 1-100 gr. every three hours, during the purulent stage. Pulsatilla gtt. ss-j if apprehensive. Phytolacca gtt. ss-ij with glandular swelling and tenderness.

*Prophylaxis.*—A person suffering from gonorrhea should be warned of the danger of infecting not only their own eyes, but also those of other persons with whom they may associate. The use of towels, Etc., should never be promiscuous, and the careful cleansing of the hands after handling the affected parts will be a safeguard against ocular affection.

As the disease is usually of one eye only at the start, the protection of the unaffected eye is a matter of prime importance, and is best secured by a device similar to Buller's shield. This consists of a watchglass fitted in a piece of rubber adhesive plaster, which is applied to the brow, temple, nose and lower margin of the orbit. The inner margin should be sealed with flexible collodion, as at this point the secretion is most likely to creep under the dressing. A plate of mica makes a lighter guard, and there is less danger of injury to the eye if by any means the guard should receive a blow.

*Prognosis.*—Always serious, as the disease is as a rule virulent.

CROUPOUS OR PSEUDO-MEMBRANOUS CONJUNCTIVITIS (Plastic, Membranous Conjunctivitis).

This disease is usually divided into two forms. The first being an inflammation of the conjunctiva with soft, generally painless swelling of the lids, a membranous exudation upon the conjunctiva, and a scanty sero-purulent discharge. Except in complicated forms the disease is seldom seen. The age selected is from six months to seven years, seldom earlier, and but rarely later.

*Causes.*—Nothing definite is known regarding the cause, but there seems to be a relation between it and scrofula and



eczema. Croupous diseases of the respiratory tract may be present and may possibly be the exciting cause. It is claimed by many that it is a mild diphtheria.

*Symptoms.*—First acute conjunctivitis, followed soon by swelling of the lids, which however remain soft and pliable to the touch; this manipulation seldom causes pain. In a few days there is the characteristic false membrane composed of coagulated fibrin, of a translucent and porcelain-like appearance, beginning at the retrotarsal folds, covering the inner surface of the lids, but not invading the ocular conjunctiva. The membrane may be readily removed, showing a granular and somewhat bleeding surface. The membrane is quickly reproduced. In this form of the disease the cornea is seldom affected.

Healing takes place in from ten days to a month, excepting in rare instances.

*Diagnosis.*—May be mistaken for diphtheritic conjunctivitis, but on account of the age of the patient should not be mistaken for ophthalmia neonatorum. The discharge is not so profuse or purulent as in the latter disease, and is distinguished from the former by the membrane being more superficial, and the swelling of the lids softer.

The second form of the disease is rapid in development and associated with swelling of the lids and copious discharge, the cornea being especially liable to destructive changes. It occurs in children during an attack of measles, scarlet fever and La Grippe. It has been observed by some independently of any febrile complications, and has been associated with impetigo.

*Prognosis.*—Unfavorable, both as regards vision and life itself.

*Treatment.*—Does not vary in the two forms. If one eye only is affected, precautions against infection of the healthy eye must be observed. Rigid cleanliness is of the utmost importance. No force should be used in removing the membranes, as the raw surface left is quickly covered again, and the

deeper structures may become affected. All loose shreds of mucus should of course be removed.

The use of caustics or strong astringents is always contra-indicated unless in the purulent stage, and then they should be carefully used or more damage than good will be done.

Before the membrane forms, the use of iced cloths may prove beneficial, unless corneal complications are present, then the use of hot applications will prove better. This also will probably hold good after the membrane has formed. The discharges may be washed away with weak solutions of chloride of sodium or chlorate of potassium; chlorine water well diluted has also been used. Salicylic acid (1-2000), may be beneficial. The boric acid wash should not be neglected.

Mydriatics when corneal complications exist, while at times the myotics may have to be employed also. Internally aconite gtt. 1-6 to 1-3 during the acute stage. Bichromate potassium 1-100 gr. as long as membranous formation is present. Jaborandi in full doses should give good results during the exudative stages. Phytolacca gtt. ss to jss if any glandular disturbance is present. Apis gtt. 1-15 to 1-10 or apocynum gtt. 1-3 to j with the edematous condition. Sulphide of calcium 1-100 gr. if purulent.

DIPHTHERITIC CONJUNCTIVITIS.—Fortunately this disease is seldom seen in this country. The danger to the integrity of the eye is excessive, and even if the eyesight is not impaired, there is often more or less deformity of the lids as a result of the disease. The disease is a purulent inflammation, spreads by infection, and the secretion is contagious. It may exist either alone or associated with diphtheria of the air passages. It may also occur during the course of a purulent conjunctivitis. Eczema of the face and lids has been followed by the disease. It sometimes occurs as a complication of an acute illness, scarlet fever or measles. During an epidemic of diphtheria it may be a complication. Most frequently seen between the ages of two and eight.



*Symptoms.*—A hard board-like feeling of the swollen lids, which cannot be everted readily. Chemosis and congestion of the conjunctiva. The formation of the membrane which may be confluent or not, the color has a dull grayish appearance, and can only be removed with difficulty. When the process is deep, the subjacent structure is pale, infiltrated, and when cut into will not bleed, owing to the constriction of the bloodvessels. The lid presents a "lardaceous" appearance in the severe cases, while in the milder forms there may be one or two smooth, depressed places of a grayish-yellow color where the exudate is excessive. Between these patches the conjunctiva is swollen, red and bleeds easily.

The adjacent skin may show diphtheritic patches, and the lymphatic glands of the region may be affected. The secretion is sanious and contains flakes of diphtheritic material. During this stage the danger to the corneal tissue is excessive, as it is extremely difficult to open the lids enough to keep the eye free from secretion, while the constriction on the nutrient vessels of the cornea is also a menace.

General constitutional disturbances, as fever, alimentary derangement and nervousness, are usually present during this stage.

The stage of infiltration lasts from five to ten days as a rule, and sloughing of the cornea may occur during this time. In the second stage the lids lose their hardness and a copious discharge of fibrinous material appears. The yellowish appearance is lost and the hardness of the lids subsides, the disease having the appearance of purulent conjunctivitis. However there is sloughing of the gangrenous portions of the tissue, followed by granulating surfaces, which are likely to form adhesions between the lid and eyeball, causing symblepharon.

Protection of the sound eye should be attempted in every case, though it will not always prove effective.

*Prognosis.*—Always doubtful; the earlier the corneal complications the more serious the outcome.

*Treatment.*—This does not vary materially from that given under croupous conjunctivitis. The boric acid wash should be used in either case. The other solutions also being tried. Corneal complications should be met with atropine, as this will meet the greatest number of cases. If peripheral ulcerations occur, the use of eserine should be associated with the atropine.

SCROFULOUS, LYMPHATIC, OR STRUMOUS CONJUNCTIVITIS, (Phlyctenular Conjunctivitis, Herpes Conjunctivæ, Eczema of the Conjunctiva).

The type of this disease consists in sharply circumscribed elevations, grayish in color, and usually situated at the sclero-corneal margin. There is a corresponding injected area of the conjunctiva. There may be but one of the elevations, but as a rule they are multiple.

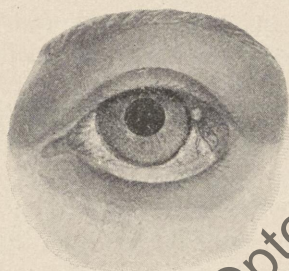


FIG. 22.—Scrofulous Conjunctivitis.

*Causes.*—Generally ascribed to constitutional conditions, as it is common in those of a strumous diathesis, or badly nourished children. It is seldom seen under the age of one year, and as a rule not after puberty. Errors of diet are prolific causes of this disease, especially the overfeeding of sweets. The disease not infrequently follows scarlet fever, measles, typhoid fever, whooping-cough, Etc.

Bad hygienic conditions, not only at home but in the school room, are also factors. Rhinitis is present in nearly every case. The lymphatic glands of the neck and around



the ear are usually enlarged, and suppuration of the glands is not unusual. The lids are often reddened and thickened (blepharitis).

*Symptoms.*—One or more small elevations, at or near the corneal margin, in the conjunctiva. In the early stage, the prominences are conical, the conjunctival epithelium covering the entire swelling. The contents of the vesicles is an exudate, not fluid, as a rule, but an aggregation of lymphoid cells. The apex of the vesicle soon breaks down, leaving a small gray ulcer. The breaking down process continuing, the cone disappears, the ulcer sinking to the level of the conjunctiva soon heals over through the formation of new epithelium. If however the ulceration extends deeper, the corneal tissues may be implicated, a true keratitis resulting.

The vascularization of the conjunctiva may be limited to the region of the bleb if single, the apex at this point, and spreading out in a cone shape toward the circumference of the ball, or if multiple, the entire conjunctiva may be congested.

Sometimes these phlyctenules assume considerable size and are filled with a purulent secretion, when the term *pustular ophthalmia* is given.

The pain in scrofulous conjunctivitis is nearly always severe, varying with the individual and the location of the vesicles; the nearer the corneal margin the more severe the symptoms as a rule. Photophobia and increased lachrymation being present almost universally. The dread of light may be so great that it will be almost impossible to get the patient out of a dark room, even long enough to make a satisfactory examination. After the exanthemata, the rule is for this disease to be associated with a muco-purulent conjunctivitis.

The tears are so acrid in many cases that an eczema will make its appearance over the cheeks where the tears keep the skin moist.

The disease subsides in from ten days to two weeks in the ordinary cases, only to reappear on the slightest provocation.

*Prognosis.*—Usually favorable, unless the disease assumes the deeper form, and the cornea has been affected to any considerable degree, when there will be more or less diminution of vision.

*Treatment.*—Locally mild astringent collyria, especially the hydrastis and boric acid. If irritation is excessive, and the vesicles encroach on the cornea, the use of atropine solution to produce full dilatation of the pupil will be found to give relief. The wash of boric acid to keep the eyes clean is important. The habit of using cocaine in these cases is to be condemned; it may be necessary for the purpose of making an examination of the eye, but on account of the well known effect of the drug on the corneal epithelium, it is not a safe drug to use. After the acute symptoms have subsided, the use of the yellow oxide of mercury ointment will often be found beneficial. The ointment should not be used stronger than gr. j to 3j of the base, and should be carefully prepared so no lumps of the mercury are in the ointment.

The eye should be protected from bright light, but excepting in rare cases a bandage is not necessary.

Success in treating this disease will however result from rigid attention to the general health. Good hygienic conditions must be insisted upon, exercise in the open air, not during the brightest light of the day however. Good plain, easily digested food. Internally the administration of lime in some form. If the patient is anemic iodide of arsenic gr. i-200 to i-100. If a syphilitic taint is present iodide of potassium grs. j to iij.; with swollen lymphatic glands, phytolacca gtt. ss to j; edema of the lids, either apis or apocynum. If much burning is complained of, and restlessness is present, rhus tox. gtt. i-15 to i-10. Fever calls for aconite. If the secretion is tenacious, bichromate of potassium. If an atonic condition of the alimentary canal, nux vom. Pulsatilla when the patient is apprehensive.

SPRING CONJUNCTIVITIS (Fruehjahr's Catarrh, Vernal Catarrh, Circumcorneal Hypertrophy of the Conjunctiva, Phlyctæna Pallida).



"Spring catarrh is the only process in the human body, with the exception of freckles, that is exclusively dependent on atmospheric heat."—*Haab*.

This disease makes its appearance usually at the upper margin of the cornea, and forms a more or less complete band around the cornea. The surface of the band is uneven, dirty gray in color, and from 1-12 inch to 1-8 inch in width. The swelling may be so much that it covers considerable of the corneal surface. Hyperemia of the ocular conjunctiva is not always present. The conjunctiva of the lids is always hyperemic, and often swollen. The surface looks as though it was covered with a fine dust, or the granules may be quite large, consisting of hard flattened masses, pinkish in color as a rule. Sometimes the conjunctival surface has the appearance of being covered with a thin layer of milk.

There is a feeling of discomfort, with burning, itching and heaviness of the lids, sometimes so marked as to cause ptosis. There is but little discharge from the eyes as a rule, although there will be a collection of shreds of mucus or muco-pus at the retrotarsal folds.

The disease occurs mostly among children and young people. There seems to be no special cause for the disorder excepting warm weather.

*Treatment*.—The same general line as given under scrofulous conjunctivitis, but no treatment yields satisfactory results.

**FOLLICULAR CONJUNCTIVITIS (Trachoma Folliculare).**—This disease is characterized by small granules covering the conjunctival surface of the lids, more particularly in the retrotarsal folds. The granules may appear singly or in rows, when they are parallel with the edge of the lid as a rule. The bodies vary in size from a pin point to that of a rape seed. They are reddish or yellowish in color, except the larger ones which may be more or less transparent.

It is a disease of childhood and early adult life. There may be no marked subjective symptoms, or a more or less

constant blinking and inability to use the eyes for close work may be present. The secretion as a rule is scanty.

*Causes.*—Poor hygienic conditions, especially the overcrowding of school rooms, and the use of the eyes in bad light. Refractive errors are undoubtedly a cause in some cases, especially where the lower lid only is affected. Occasionally the disease is the result of a purulent or muco-purulent conjunctivitis, or of a mild type of congestion or inflammation of long standing. The simple form has been attributed to adenoid activity.

*Diagnosis.*—The distinction between this disease and trachoma is, that in follicular conjunctivitis the granulations are most numerous in the lower retrotarsal fold; the conjunctiva may be thickened, but is soft and pliable. The mucous membrane is not affected more deeply than the follicles, and no cicatricial changes are present between the masses.

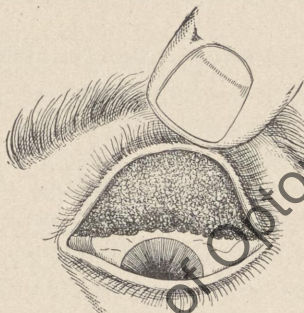


FIG. 23.—Follicular Conjunctivitis.

*Prognosis.*—Usually good if proper hygienic surroundings can be obtained, although the disease may run a tedious course.

*Treatment.*—If any refractive errors exist they should be corrected. Errors of diet and unsanitary surroundings amended. The nasal cavities should receive attention, as in some cases the cause of the disease is located here. Locally



the use of boric acid wash is desirable for cleansing purposes. The hydrastis collyrium, sometimes combined with sulphate of morphine will give relief in the majority of cases. The application of an ointment of boric acid at night will often be grateful to the patient. In aggravated cases the expression of the follicles, either by means of Knapp's roller forceps, or squeezing the lids between the thumb nails will hasten recovery. Internally the use of arsenic in some form, especially in anemic persons, will be found beneficial. Calcium in strumous subjects, especially young patients, should not be forgotten, as these nearly always need lime, there seeming to be a lack of lime salts in the tissues of the body. Enlarged glands call for phytolacca. Here as in all cases of eye diseases, proper constitutional remedies should be employed, and the indications for a drug are always the same.

TRACHOMA (Granular Conjunctivitis, Granular Ophthalmia, Egyptian Ophthalmia, Military Ophthalmia, Granulated Lids).

This disease is evidently an infectious inflammation of the conjunctiva, the membrane losing its smooth surface through the formation of rounded granulations, which when absorbed leave cicatricial changes. The disease is one of the most important of all inflammatory conditions affecting the conjunctiva. Two forms are recognized, acute and chronic.

In the acute form which is not common, there is a more or less purulent secretion, which is very contagious. The disease may have its inception in bad hygienic surroundings, and is especially liable to develop in over-crowded institutions, either public or private. The subjects as a rule being found among the badly nourished, or those enfeebled by scrofulous or tubercular constitutions.

The chronic form is so insidious in its outset that it may escape detection for a long time, or until some of the complications make their appearance. It may result from imperfect cure of the acute type, thus leaving a nidus for the chronic form. In the majority of cases however, no history

of infection can be obtained. Social distinctions are not a bar to the disease, although it is not so often found among the so-called better classes. The negro race in this country seems to be the most immune of any.

*Complications.*—In old cases fibroid degeneration takes place in the conjunctiva, finally atrophying and leaving grayish-white cicatricial bands, which usually are parallel with the lid border. These bands are generally at first very narrow whitish striæ in the conjunctiva. Eventually these unite, implicating the entire conjunctival surface, which presents a pale, thin and smooth appearance. Distortion of the lid often occurs in these cases through the cicatricial contraction, resulting in entropion. Symblepharon also sometimes occurs as a result of the disease. Atrophy and shrinking of the conjunctiva may occur, and pannus is a frequent result, as well as ulceration of the cornea. The entire corneal structures may be affected to such a degree as to cause weakening of the tissues, allowing the cornea to bulge forward through intra-ocular tension.

*Course.*—Insidious in character. The granulations increasing in size, become covered with fine capillaries; the conjunctiva red and infiltrated, secretes a muco-purulent discharge; the papillæ swell and blend with the granules, giving the surface the appearance of a fleshy mass. Following this a retrograde movement sets in which terminates in the cicatricial changes already spoken of.

*Symptoms.*—Acute trachoma. Lids swollen, conjunctiva reddened, papillæ enlarged, and between them the non-vascular, roundish granulations. Photophobia usually marked, and on separating the lids scalding tears gush out. The ocular conjunctiva injected, superficial vascularity of the cornea, with sometimes ulceration, especially at the margin. Pain referred to the eyebrow and temple. The discharge is at first usually scanty, but soon becomes profuse and muco-purulent, followed later by a purulent secretion. The disease may terminate by absorption of the granulations, or may run into the chronic form.



Chronic trachoma often comes on without any symptoms, the patient not being aware of any serious trouble. The granulations are generally grayish-white, semi-transparent bodies, varying in size, and may be on the lower lid, although the upper is the usual choice. The granulations have been likened to sago grains, and some give the appearance as similar to frog-spawn. The angle of the lids and the upper retrotarsal fold are the favorite locations for these granulations, hence a careful examination should be made of these parts. In cases of long standing, the scar tissue having formed, is firmly adherent to the tarsus, thus causing deformity of the lids. During the thickening stage of the disease, the lids do not open fully, a partial ptosis resulting, causing a sleepy look to the patient.

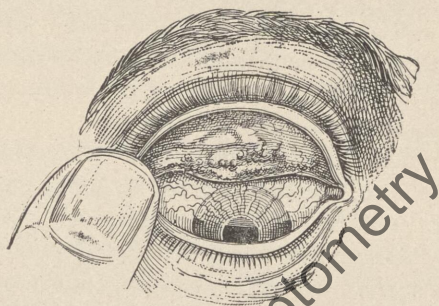


FIG. 2.—Typical Granulated Lid, beginning cicatrization and pannus.

Granulations are sometimes found upon the caruncle and semilunar folds. The mucous membrane is pale or yellowish-red, rough in places, and contains follicles which are more or less deeply situated.

*Diagnosis.*—Ordinarily not difficult, although acute granulations may be mistaken for purulent conjunctivitis. In the chronic form as a rule the diagnosis is not difficult on inspection of the everted lids, unless the associated swelling of the papillæ obscures the granulations.

## TRACHOMA.

The upper lid usually the most affected, especially the retrotarsal fold and the lid angles. The granulations often arranged in parallel rows and presenting reddish or grayish-white ovoid bodies semitransparent in appearance and imbedded in the conjunctiva. These granulations are situated in the membrane between the papillæ. Cicatricial changes always occur, the bands of tissue running parallel with the lid margins. Deformity of the lids not unusual. Pain is present in the majority of cases. Seldom seen in children.

## FOLLICULAR CONJUNCTIVITIS.

The lower lid usually the most affected, especially at the cul-de-sac. The elevations prominent and not imbedded in the conjunctiva. No cicatricial changes result. Pain not present. Occurs in children.

*Prognosis.*—Under the most favorable circumstances a complete cure is slow, frequent relapses are almost sure to occur, and severe inflammatory action retards recovery. If greater care is taken in making the diagnosis, there will not be so many rapid cures reported. The contagious character must be borne in mind, and every precaution taken to prevent an epidemic of the disease. Time and plenty of it must be given for effecting a cure, and guarded statements regarding resulting vision must be made.

*Treatment.*—This should consist of hygienic, constitutional and local. Cleanliness of the eyes is important, and it should be unnecessary to insist upon individual towels, etc., but this is too often neglected. Avoidance of irritating vapors, dust, etc., plenty of exercise in the open air and good food are all necessary.

In the acute form of the disease, or during acute inflammatory relapses, the use of iced cloths will afford relief. The use of a collyrium of Lloyd's ergot gtt. xx to fl. ʒss, sol. boric acid q. s. fl. ʒss, used every two or three hours after the eyes have been washed with the boric acid wash



has given good results, the action being to contract the blood-vessels and assist in allaying the inflammatory action. The same general line of treatment should be employed as in acute conjunctivitis of a purulent character.

In the chronic form, especially if pannus exists, local measures are important. The use of the douche will in the majority of cases give results that no other form of treatment will produce. The water should be used at first at a temperature of  $108^{\circ}$  F. running about a gallon over the eyeball. A fountain syringe is the best, and the bag should not be placed at too high a point above the eye. A tip that will throw a flat stream is preferable. The temperature should be increased each sitting until a temperature of  $116^{\circ}$  F. is reached. Boric acid should be dissolved in the water, as clear water will produce some irritation.

The application of strong caustics should never be made. Strong astringents also will do harm in the hands of a careless individual, and even with the best of care there is a likelihood of producing more cicatricial contraction than is desirable. A solution of nitrate of silver gr. iij to viij to fl. ʒj. may be used by the physician, but should never be placed in the patient's possession. Salicylic acid in solution of 1-2000 to 1-1000 may be tried. The use of corrosive sublimate in solutions of from 1-2000 to 1-1000 has been recommended, making the application to the conjunctival surface of the lids with a brush or hard wad of cotton. This is not to be recommended if ulceration of the cornea is present. The use of *thuja* in these cases has been recommended, but I have been disappointed in the drug. Nearly every oculist has a favorite preparation for this disease.

The operative treatment consists in expression of the contents of the follicles by means of the thumb nails, Knapp's roller forceps, or Noyes' trachoma forceps. Excision of the diseased retrotarsal folds is highly recommended by some and as strongly denounced by others.

Expression, either combined with grattage or not, as re-

quired, is the least destructive to tissue and gives the best results. The simple operation is the best where the granules are not numerous and the conjunctiva not thickened. If a thickened conjunctiva is associated with numerous granulations, grattage, that is horizontal parallel incisions in the membrane, should be made before expression. It is important to reach all diseased tissue, else there is a quick return of the disease.

*Constitutional Treatment.*—This will not vary essentially from that already given under other forms of conjunctivitis, the indicated remedy being employed.

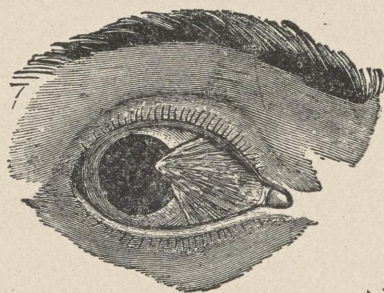


FIG. 25.—Pterygium.—*Hansell and Welch.*

**PTERYGIUM.**—A vascular, triangular thickening of the conjunctiva, its apex toward the cornea, the base toward the canthus of the same side. Occasionally two occur on the same eye, the bases being on opposite sides of the ball. Both eyes may be affected. The apex of the growth seldom extends beyond the center of the cornea. The favorite location is on the nasal side of the globe, corresponding to the course of the internal rectus muscle. The growth is usually slow, and is seldom seen in young persons.

During the progressive stage, the mass is prominent, vascular, and with clearly defined edges. After the subsidence of the progressive stage, the vessels are not so numerous and are smaller in size, the tissue having a lax appearance, and the edges are not sharply defined.



Irritation of the conjunctiva or inflammatory action increases the vascularization, and increases the disreputable appearance.

*Causes.*—Obscure. The present opinion being that it develops from a pinguecula, and as a rule belongs to senile changes of the eye. Persons exposed to irritating vapors, dust, bright light, heat, etc., seem especially prone to this affection.

*Prognosis.*—Depends upon how much corneal surface has been covered, or if it has extended far, there is always some diminution of vision.

*Treatment.*—Operative. See operations.

PINGUECULA.—A small yellowish elevation, usually round in outline, situated generally on the nasal side of the conjunctiva over the insertion of the internal rectus muscle, and near the cornea. "The color is due to hyaline degeneration and an overgrowth of elastic fibre" (Haab). Usually there is no inconvenience from the growth.

*Cause.*—Supposed to be due to local irritation, but is not certainly known.

*Treatment.*—Removal by scissors is the only method if any thing is done at all.

ECCHYMOSIS OF THE CONJUNCTIVA.—Extravasation of blood under the conjunctiva.

*Causes.*—Injury to the eyeball. Violent coughing or sneezing. Any exertion which causes the blood to rush to the head. Direct traumatism. Not infrequent in children with whooping-cough, and is seen frequently among the aged and those whose vascular walls are weakened. In young girls approaching the menstrual period this condition has been seen.

Ecchymosis of the conjunctiva after injuries to the head not involving the eye indicates a possible fracture at the base of the skull.

*Treatment.*—Time is the remedy, although the use of boric acid wash may help through psychological influence.

**EMPHYSEMA OF THE CONJUNCTIVA.**—A distention of the connective tissue spaces with air. Is caused by similar conditions as produce the same conditions of the lids.

*Diagnosis.*—Feeling of crepitation under the finger will make a mistake impossible.

*Treatment.*—A compression bandage may be used. Having the patient avoid blowing the nose to prevent a recurrence.

**CHEMOSIS OF THE CONJUNCTIVA (Edema).**—A condition in which the connective tissue is filled with serum so as to cause distention. The cornea is seen at the bottom of a crater-like elevation formed by the conjunctival tissues. The color of the eye is a pale pink or yellow, and transparent in appearance. As a rule it is symptomatic.

*Causes.*—Acute conjunctivitis, choroiditis, iritis, or orbital cellulitis. Sometimes seen in acute glaucoma. In paralysis of the external rectus the overlying tissues may become edematous, and this may be an early sign of this trouble. A general urticaria has also caused it. Iodide of potassium has also been given credit. Quinine has been known to produce the symptom. One persistent, recurring case under observation was caused by loss of sleep and the abuse of alcoholics.

*Treatment.*—The cause of the condition must be treated, but if the swelling is so great as to endanger the nutrition of the cornea, it may be necessary to puncture the conjunctiva. Internally the use of apocynum has always given relief, either alone or with apis. Locally the use of warm boric acid solution will often be grateful.

**LYMPHANGIECTASIS OF THE CONJUNCTIVA.**—Obstruction of the lymph channels of the conjunctiva, causing the lymphatic walls to be distended, giving the appearance of small blisters. These bodies are filled with semi-transparent fluid, and are multiple as a rule. Seen most frequently in children and young people. As a rule there is not much discomfort, and they disappear usually in a short time without any



treatment. If they are annoying a small incision will evacuate the contents.

**SUB-ACUTE CONJUNCTIVITIS.**—A condition characterized by reddened lid margins, congested conjunctiva, and increased conjunctival secretion. The disease may also assume a chronic type continuing in rare cases for months, as a rule it is an insidious disease.

*Treatment.*—Does not vary from that already given for conjunctivitis.

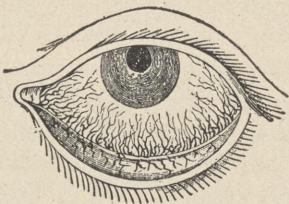


FIG. 26.—Congestion of posterior Conjunctival vessels.

**PARINAUD'S CONJUNCTIVITIS.**—Supposed by Parinaud to be the result of infection from animals. The lids are swollen, the conjunctiva in a short time showing polypoid granulation with an ulcerative condition between. The discharge is muco-purulent. The lymphatic glands of the same side of the head are enlarged and may suppurate. But one eye is affected as a rule. The disease is usually severe during the formative stage, a slight chill followed by fever and often considerable general depression may be present. The disease may be mistaken for acute trachoma but the character of the granulations are different, and in trachoma there is no inflammatory action involving the lymphatics.

*Prognosis.*—Usually good. The time required however for a cure may be several months.

*Treatment.*—If the granulations are not too numerous they may be excised. The use of a solution of salicylic acid, 1-2000, or a collyrium of Lloyd's thuja fl. 3ss, aqua destillat. q.s. 4-5ss. Mix. Brushing this solution lightly over the everted lids may have some influence. No local treatment

however appears to have much effect. Constitutional measures should be such as will restore the tissues to their normal condition. Lime in some form, as well as phytolacca should be given on account of the lymphatic complications.

**LACHRYMAL CONJUNCTIVITIS.**—This term is sometimes used to designate a chronic conjunctivitis originating from an obstructed nasal duct. The secretions being retained in the lachrymal sac, soon undergo a change, and produce irritation of the lid margin surrounding the puncta. When the pressure of the retained secretion becomes sufficient, some of it will pass backward through the canaliculus and increase the irritation which eventually causes conjunctivitis.

*Treatment.*—The lachrymal passages must be kept free; this in connection with the usual treatment for blepharitis and conjunctivitis may prove sufficient.

**LITHIASIS OF THE CONJUNCTIVA.**—A condition found oftener among the aged than in young persons. Rheumatic or gouty conditions seem to favor its development. Eversion of the lids reveals small whitish bodies embedded in the conjunctiva near the lid margin, they seem to be calcareous and formed of degenerated Meibomian gland secretion. These acting as foreign substances, may produce considerable irritation and cause a sub-acute or chronic conjunctivitis.

*Treatment.*—Removal of each with a fine needle or knife; the work can be more readily done by first using cocaine.

**TOXIC CONJUNCTIVITIS.**—A conjunctivitis may result from the use of mydriatics, myotics or exposure to irritating chemicals.

*Treatment.*—Removal of the cause, and use boric acid wash, or boric acid ointment.

**XEROSIS.** Xerophthalmia, Atrophy of the Conjunctiva). — There is a dry shrunken looking conjunctiva. Cicatrization resulting from trachoma may produce this appearance of the tissue of the lids, but in this disease the bulbar



conjunctiva may be affected without any previous morbid condition. When the disease is a primary one, there may be seen a frothy secretion covering the exposed portion of the globe; this secretion may be washed away, but soon reappears. More or less anesthesia of the conjunctiva is present. Increased lachrymation does not follow irritation of the membrane.

In severe cases not only the lachrymal secretion is wanting, but the retrotarsal folds are obliterated through shrinking of the conjunctiva. The cornea in these cases often presents a dull hazy appearance and sloughing sometimes occurs, blindness resulting. Night blindness is usually present in patients old enough to notice this condition. The disease appears to be due to perverted nutrition. The central nervous system appears to be the starting point, as evidenced not only by the anesthesia of the retina (night blindness), but also by the atrophied lachrymal gland, conjunctiva and cornea.

Infants often develop lung or intestinal diseases in these cases, which prove fatal.

*Treatment.*—Consists in restoring normal secretion if possible, and the local use of bland emollient preparations. White vaseline is probably best. The use of boric acid in these cases is not advisable, as the action of the drug is to diminish secretion and in this condition would further aggravate the disease.

**AMYLOID DEGENERATION.**—A disease very seldom seen in this country. The morbid process usually commences in the retrotarsal folds and may invade both the palpebral and bulbar conjunctiva, the latter not so frequently as the former. Amyloid bodies are present in the thickened conjunctiva and the upper lid sometimes becomes so thickened and heavy that ptosis results. The disease is chronic and there is no pain, lachrymation or discharge.

*Treatment.*—Operative. The removal of the mass being generally followed by atrophy of the remainder.

**ABSCCESS OF THE CONJUNCTIVA.**—This may occur as a circumscribed purulent area in the mucous tissue. It may result from an injury, but at times independently of such a cause.

*Treatment.*—After the formation of pus, a free incision should be made and the eye kept scrupulously clean by the use of the solution of boric acid. Constitutional measures if indicated.

**SYPHILIS OF THE CONJUNCTIVA.**—The primary lesion may occur near the inner canthus, or upper or lower cul-de-sac. The lesion does not differ essentially from that found in other regions. Syphilitic conditions of the conjunctiva may also occur during any stage of the disease. Gumma is seldom seen. A chronic ulcer with extensive infiltration may occur during the later stages of syphilis. A conjunctivitis which is not very amenable to local treatment sometimes develops, (syphilitic conjunctivitis). It may assume a catarrhal form or there may be granulations, resembling trachoma, which develop in a pale conjunctiva. Indurated glands are to be looked for in these cases.

*Treatment.*—Local measures are of no especial value excepting for the purpose of cleanliness. Internally iodide of potassium is the main reliance and other remedies as indicated.

**LEPROSY.**—This disease as a rule does not attack the conjunctiva primarily. The cornea is most frequently the primary point of attack, spreading to the conjunctiva. Lopez states that the leprous tubercles appear usually at the corneo-scleral margin and resemble those developed in the skin. Pterygia are frequent, and there is an anesthetic condition of the conjunctiva and cornea.

**TUBERCULOSIS — LUPUS.**—Clinically when the morbid process begins in the conjunctiva it is tubercular, but when primarily the disease is in the skin, invading the conjunctiva secondarily, it is lupus. The characteristics are the same in both. When primarily in the conjunctiva there



will be yellowish or reddened nodules somewhat resembling trachoma, but ulceration of the nodules and lack of the "sago-grain" appearance will aid in differentiating. The edges of the ulcer are ragged and the uneven bottom is more or less covered with pus.

The conjunctiva of the lid is most frequently attacked, although it may invade any portion of the conjunctiva. When the ulceration is close to the cornea, this structure, although not ulcerated, will be more or less clouded. If the destruction of the cornea is extensive, symblepharon may result during the healing process. The lids, although nearly always thickened, are not hard to the touch. The discharge is muco-purulent, but rather scanty. Unless the cornea is invaded, there is seldom much pain. One eye alone may be affected, or both may be, either at the same time or successively. The glands in front of the ear, as well as the sub-maxillary glands of the affected side, are enlarged.

In lupus the characteristics are similar to the above, excepting the disease starts primarily on the face, and invades the conjunctiva through extension.

*Prognosis.*—Not favorable.

*Treatment.*—If the nodes or ulcers are not too extensive, the use of nitrate of silver or pure carbolic acid, getting the agent well down into the morbid mass, may produce good results. If excision of the mass can be done, this is the quicker method. Employment of any of these measures when the amount of tissue invaded is considerable, is not advisable. A solution of salicylic acid 1-2000, or a saturated solution of boric acid may be used. Dusting the surface with iodoform or menthol may be beneficial, but the treatment of this disease as yet is empirical. Internally the best results seem to follow the use of phytolacca and hydrastis.

PEMPHIGUS.—Very rarely seen and when it is, is usually associated with pemphigus of the body. It occurs in the form of blebs on the fornix or ocular surface. Ulceration occurs and the affected area shrinks. These blebs keep ap-

pearing until cicatricial changes of the entire conjunctiva have occurred, and sometimes symblepharon and ankyloblepharon result. Very early in the disease the cornea becomes affected, and the condition goes from bad to worse with the conjunctival changes.

A condition called essential atrophy of the conjunctiva is sometimes described, but it is likely that it is similar or the same as just given.

*Prognosis.*—Bad.

*Treatment.*—Palliative measures, as so far neither local nor constitutional treatment appears to have any effect. Operative measures have also been a failure.

**TUMORS, CYSTS, Etc., of the Conjunctiva.**—Almost all forms of morbid growths found elsewhere in the body, are found on the conjunctival surface, and they do not materially differ from them, excepting as the location would modify them. They are both benign and malignant.

**BENIGN TUMORS.**—Dermoid tumors are the most common. They nearly always invade the corneal tissue more or less. These growths are congenital, at least in the majority of cases, and are associated with other malformations of the eye or face. The mass consists of stroma or connective tissue, covered with epidermis, contains hair follicles, sebaceous glands and sweat glands. It is covered with down or longer hair, and varies in consistency according to the amount of fat contained in the tissues. The lower external edge of the cornea is the favorite location, and the size varies from a small pea to double this. The color varies, being white, yellowish or reddish. Operative interference is the only method of removal, and this should be cleanly done, as otherwise a partial return is probable. The operation is demanded more for the cosmetic effect than anything else as a rule.

**LIPOMA.**—Not often seen. Usually congenital and situated above the rectus externus muscle. The color is yellowish, the shape triangular, usually with the base toward



the cornea. When the tumor is small it is concealed by the outer canthus, but may be brought into view by turning the eye strongly inward. Generally no treatment is required, but if demanded the conjunctiva should be divided over the mass, and remove as much of the fatty tissue as is visible in the palpebral fissure.

Granulation tumors are common, and are the result of traumatism, either operative or accidental. The mass should be removed with scissors curved on the flat.

Cysts in the conjunctiva are commonly represented by small vesicles filled with limpid fluid. The color may vary from white to yellow or reddish. The contents may be thin and watery, or thick and viscid. They may be congenital or the result of traumatism. The treatment consists usually in ablation.

**MALIGNANT TUMORS.—EPITHELIOMA OF THE CONJUNCTIVA.**—A flat sessile tumor with a broad base. The slowness of growth and the age of the patient will aid in the diagnosis. In the later stages the growth invades the corneal tissues, causing an appearance of pannus, the mass itself being puffy, red or pink in color, lobulated and ulcerated. Removal is the only treatment, and if there is a return the eye will have to be enucleated.

**CYSTICERCUS UNDER THE CONJUNCTIVA.**—The cysticercus cellulose sometimes makes its home under the conjunctiva. If seen early it appears as a transparent cyst in the interior of which the head of the parasite can be sometimes seen. After a time the vascularization of the overlying conjunctiva produces thickening and an opaque condition of the membrane, so the diagnosis is more difficult. It is found as a rule on either the nasal or temporal side of the cornea.

*Treatment.*—Consists in making an incision in the conjunctiva over the cyst, and removing it.

**SARCOMA OF THE CONJUNCTIVA.**—Like epithelioma usually begins at or near the corneal margin. The growth is usually pigmented, and is pedunculated, and may overhang

the cornea without invading it. The growth is very destructive, and should be early removed. If the growth is not recognized early, the eye should be removed.

**INJURIES OF THE CONJUNCTIVA.—*Foreign Bodies.***—These may be dust, particles of coal, emery, chaff of seeds, insects, in fact nearly anything that is small enough to enter the eye. If the substance is embedded in the mucous membrane, its removal may have to be made with a spud or needle. Particles of steel may penetrate so deeply that the tissue will have to be picked up with forceps and incised, bringing away the offending particle in this way. The foreign body may be so far back under the retrotarsal folds that it is difficult to expose it to view. If loose there is not much difficulty in removing the body, but when embedded the use of cocaine will facilitate the work. A careful examination of the conjunctival and corneal surfaces should always be made to insure the removal of all particles, as the patient in rubbing the lids against the eyeball will, if the body is brittle, very likely break the substance into several pieces. In all probability there will have been enough abrasion of the conjunctival or corneal surfaces to incline the patient to the belief that you have not removed the cause of discomfort. Remember where there is abrasion of the tissues there will be a "scratching" sensation for several hours. In these cases the use of cold boric acid wash will give relief. Sometimes the instillation of castor oil, or the introduction of a little plain vaseline will allay the irritation, but the greasy film is often more annoying to the patient than the scratching.

**Wounds.**—In this condition there is a chance of injury to the lids, or the deeper structures of the eyeball. It is seldom that there is only laceration of the conjunctiva without injury to other structures. After proper cleansing, if not otherwise indicated, the edges of the wound may be approximated with sutures.



*Burns.*—Burns of the conjunctiva are not infrequent, and at times, even with the best of care, serious deformities will occur if not loss of vision, or the eye itself. Acids, hot liquids, lye, and lime are the most common, and of these lime is the commonest cause. If the case is seen early after the introduction of the lime, the eye should be thoroughly cleansed with very dilute vinegar. The introduction of fresh lard will also check the cauterizing effect. The eye should not be flushed with water as a rule unless there is no other means at hand, and if water is used it should be run over the eyeball in a rapid stream, so the cauterant action will not be increased. Castor oil may be used also. If the burn is caused by an acid, a weak alkali, as bicarbonate of sodium, should be used. Be sure all of the material is removed. Concentrated lye should be treated the same as lime. The after treatment consists in preventing as far as possible adhesions between the globe and lids. The introduction of thin plates to separate these structures has not been successful. Keeping the cul-de-sac filled with some bland, oily substance is best, and if adhesions appear they can be broken down once or twice a day by passing a probe between the globe and lid. The use of atropine is often necessary in these cases to prevent iritis. The employment of a 1 per cent. ointment of aristol in these cases will often relieve irritation and hasten healing.

*DISEASES OF THE CARUNCLE.*—This body is often swollen in severe conjunctivitis. Eye strain also appears to be a factor in increasing its size. The caruncle is reddened and prominent, and congested vessels are seen running toward the cornea. Foreign bodies upon, or perverted cilia rubbing against the caruncle may also produce this effect. A careful examination of the caruncle should be made when the patient complains of discomfort on use of the eyes, irritation, or increased lachrymation.

*TRICHOSIS CARUNCULÆ.*—An excessive development of the normal hairs of the caruncle.

ENCANTHIS.—An inflamed and enlarged caruncle independent of conjunctivitis or irritation. This condition has been divided into acute and chronic. Small suppurating points may form.

Tumors are rarely found in this body. Adenoma, sarcoma, and carcinoma have been described.

*Treatment.*—If due to refractive errors, a correction of this defect will be all that is necessary. If due to irritants, as foreign bodies, perverted cilia, or over development of the hairs, the removal of the exciting cause will be sufficient. Inflammatory conditions yield as a rule to the usual conjunctival remedies. Ergot however seems to have an especially prompt action in these cases. Tumors should be excised.

SEMI-LUNAR FOLD.—Seldom affected independently of the conjunctiva. One case presented where the thickening was excessive and simulated a band of cicatricial tissue, passing from the upper and lower cul-de-sac, the concave edge extending nearly to the cornea. There was no conjunctivitis and no history of any trouble with the eye previous to the appearance of this condition, which evidently was chronic.

*Treatment.*—The hydrastis collyrium will be all that is required.

ARGYROSIS.—A brownish discoloration of the conjunctiva resulting from the long continued application of a solution of nitrate of silver. There is no relief from this condition.



## CHAPTER V.

### DISEASES OF THE CORNEA.

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ANATOMY.—The cornea is composed of five layers which, taken from the anterior surface backward are, the anterior epithelial, Bowman's membrane, substantia propria, Descemet's membrane, and posterior endothelial layer.

*Anterior Epithelial Layer* is like the epithelium of other portions of the body, specialized for its position. It is composed of from six to eight layers of cells, and is renewed from the basement layer. This layer is continuous with the conjunctival epithelium.

*Bowman's Membrane* (anterior limiting layer).—Is clear, homogeneous, and apparently a structureless body, firmly adherent to the cornea proper, very resisting, and if destroyed by inflammatory action, is never replaced.

*Substantia Propria* (corneal substance proper).—Consists of bundles and lamella of white fibrous tissue. These are united by interfibrillar cement substance and connective tissue cells, or corneal corpuscles, occupying spaces between the fibrous bundles. In this portion of the corneal tissue are intercommunicating channels, which represent the lymph spaces, present also in other dense connective tissues.

*Descemet's Membrane* (posterior limiting membrane).—This contains no cells, and is apparently a homogeneous elastic layer. It is very firm, and is supposed to be a condensation of the cement substance of the cornea proper.

*Endothelial Layer* (posterior epithelium).—This consists of a single layer of endothelial cells.

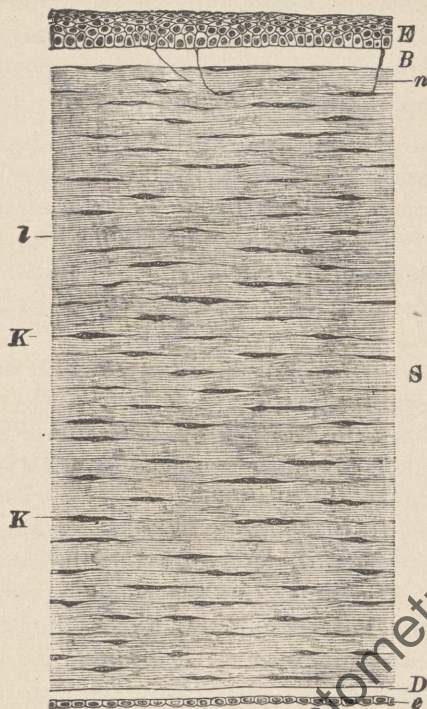


FIG. 27.—A cross section through a normal cornea. Magnified 100x1. *E*, anterior epithelium; *B*, Bowman's membrane; *S*, stroma, composed of the corneal lamellæ, *b*, and the corneal corpuscles, *K*; *D*, Descemet's membrane; *e*, posterior epithelium; *n*, nerves extending through the epithelium and Bowman's membrane.—*Fuchs*.

*Blood-vessels of the Cornea*.—Limited normally to a small zone at the periphery. The blood vessels are arranged in this narrow marginal zone in loops which encircle the cornea.

*Lymphatics of the Cornea*.—The channels in the corneal tissue being considered as lymph spaces, carry the nutritive material which is likely obtained from the marginal loops of blood vessels to the anterior portions of the cornea, while the



posterior portions are supplied with nutrition derived from the anterior chamber and distributed in a similar manner to that from the marginal loops.

*Nerves of the Cornea.*—The corneal nerves are derived from the ciliary plexus formed by the long and short ciliary nerves. These also supply the ciliary muscle and iris.

**ANOMALIES OF THE CORNEA.**—*Sclerophthalmos* (Sclerosis of the Cornea).—Where the cornea is opaque from apparent extension of the sclera into the corneal tissue. It may invade all the cornea excepting the central portion, or it may be confined to the upper portion only. In some instances it invades simply the the corneal margin, when it is called *arcus juvenilis*.

*Macrocornea.*—The cornea is abnormally increased in size as seen in buphthalmos.

*Microcornea.*—The cornea lessened in size as seen in microphthalmia. The cornea is sometimes small in otherwise normal eyes.

*Congenital Opacities.*—Spots of small opaque tissue, the result of intra-uterine disease or arrested development.

*Congenital Staphyloma.*—A rare condition which appears to result from inflammatory action during the later period of pregnancy. Heredity is probably a factor.

**KERATITIS.**—A general term applied to all forms of inflammatory action involving the cornea. The division into classes is arbitrary, and as two or more forms may be present in an individual case, it is not always possible to clearly differentiate the kind. For convenience however the type of each is taken in order to study the disease. Keratitis may be primary or secondary. It may spread from the cornea to the conjunctiva, iris, ciliary body, etc., or the inflammation may extend from any of these structures to the cornea.

A certain line of symptoms are always associated with keratitis, in varying degrees. Pericorneal injection is one of the most marked features. In the severe forms of the dis-

ease implication of the iris or ciliary body may result. Pus in the anterior chamber (hypopyon), may result. Diminution of vision, pain, photophobia, increased lachrymation, and blepharospasm are more or less marked.

**PHLYCTENULAR KERATITIS OR KERATO-CONJUNCTIVITIS** (Eczema Corneæ, Scrofulous, Strumous, or Pustular Keratitis).—Characterized by the small, grayish elevations or pustules on the corneal surface, usually near the periphery. These vary in size, though as a rule they are about the size of small pin-heads. The vesicles may be single or multiple, if the latter they are likely to be formed in a row around the border of the cornea. Pericorneal injection is usually present from the start, and the color may be deep red. If but one vesicle is present, the injection will most likely be only in the immediate tissue, and may be triangular in outline, the apex toward the pustule. The vesicles soon change color and become yellow, the top of the blebs breaking down, leaving superficial ulcers. At this stage the entire conjunctival surface will likely be congested if it was not before. Photophobia and excessive lachrymation now present, and the pain is generally out of all proportion to the amount of tissue involved. Blepharospasm is also marked, so much so that a close examination of the eye can be made only through the exercise of considerable patience.

The vesicles may keep close to the margin of the cornea, but they may creep toward the center, followed by a bundle of blood-vessels, forming the type of keratitis known as fascicular keratitis. After the healing of the ulcer the blood-vessels disappear, but leave an opaque band occupying their original position.

The most dangerous form of this disease is where but one pustule is present at the corneal border, which speedily ulcerates and is surrounded by an area of yellow infiltration. The tendency is nearly always to perforation.

*Causes.*—As in phlyctenular conjunctivitis, this is often due to improper diet. Strumous individuals are especially



subject to the disease. Astigmatism has been given as a factor also. Rhinitis and adenoid growths in the vault of the pharynx are nearly always present, and undoubtedly have an influence on the disease. Following the exanthemata the disease will often be found. The disease seldom appears in a person under one year of age, but becomes more frequent as the child approaches puberty. In adults it is seldom seen, though such cases do present.

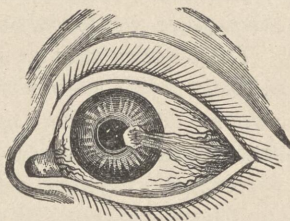


FIG. 28.—Phlyctenular Keratitis.—Hansell and Bell.

Warm and moist weather seems to favor its development. Muco-purulent conjunctivitis is often associated with this condition.

*Diagnosis.*—Not difficult if the above symptoms are borne in mind. A very important point to remember is that a thorough examination of the eyes should be made, and at times not only the protests of the patient but the parents as well will have to be disregarded. Better have nothing to do with the case than not to make a careful examination.

*Prognosis.*—Guarded. The extent of corneal tissue implicated, the general appearance of the patient, hygienic surroundings, etc., must all be taken into consideration. The liability of recurring attacks must be borne in mind, as well as the already existing destruction of corneal tissue. The diminution of vision will not be appreciable if recurring attacks can be prevented, and the lesion is confined to the margin of the cornea. If the ulcers however have been near the pupillary portion of the cornea, there will be diminution of vision corresponding to the amount of tissue in-

vaded. The resulting opacity may disappear in time, but a slight roughness of the epithelium is likely to remain.

*Treatment.*—Good hygienic conditions. Locally, cleanliness is to be obtained by the use of the boric acid wash. As a collyrium Lloyd's hydrastis, sulphate of morphine and a solution of boric acid used every two or three hours. Sulphate of atropine should be used if ulceration of the cornea is present, and the ulcer is central. Sulphate of eserine is required if the ulcer is peripheral, but if iritis is threatened the use of atropine or hydrobromate of scopolamine is indicated to keep the pupil fully dilated. The ointment of boric acid will often relieve some of the most annoying symptoms. In the later stages the employment of the yellow oxide ointment will be better.

If nasal disease is present it must be looked after. Internally in the acute stages aconite gtt. 1-10 to  $\frac{1}{6}$ . Rhus tox. gtt. 1-15 to 1-10 if a burning sensation is present. Apis gtt. 1-10 to  $\frac{1}{6}$  with scanty urine. Phytolacca gtt. ss to iss with glandular enlargement. Calcium in some form is indicated in nearly all these cases on account of the lack of lime salts in the system. Iodide of arsenic gr. 1-200 in anemic cases, and in many cases where this condition is not present this drug will be found beneficial. If a syphilitic dyscrasia is present the use of iodide of potassium gr. ss to ij, will be the remedy; this may be combined with gr. 1-100 of red iodide of mercury. Iris gtt.  $\frac{1}{4}$  to ss will be found useful in some of the specific cases with enlargement of the lymphatics. Bryonia gtt.  $\frac{1}{6}$  to  $\frac{1}{3}$  is sometimes indicated in cases where motion increases the discomfort of the patient.

The use of cocaine although very generally advised, is to be deprecated, as its action on the corneal epithelium is such as to render the tissue more susceptible to infection.

**CORNEAL ULCERS.**—This condition may result when the infiltration stage fails to terminate in absorption, the overlying corneal layers disintegrating, and forming open lesions.



Besides those described under phlyctenular keratitis, there is a division into several groups, nearly every writer forming sub-divisions of his own. The different forms are not always strictly divisible.

*Simple Ulcers.*—May result from a traumatism as well as from a single phlyctenule. Usually a superficial, small, gray lesion, with slight pericorneal injection.

*Small Central Ulcer.*—This is a gray or grayish white opacity in the center of the cornea. There is not much vascularity or photophobia. It is at first a cone shaped elevation until the top melts down, leaving a shallow depression. Generally single, although it may be multiple, and there is a decided tendency to recurrence. Usually seen in childhood among the poorly nourished and scrofulous. When recurring there will probably be considerable disturbance of vision on account of the central location of the disease. If good nutrition can be obtained early, the process will promptly disappear. When neglected, or the healing process is retarded through poor nutrition there may develop:—

*Purulent or Deep Ulcer.*—There is an area of yellowish (purulent) infiltration, with surrounding zone of hazy cornea. The excavation may be round or irregular, the tendency being toward perforation rather than lateral extension. Iritis may be a complication. Hypopyon (pus in the anterior chamber) may also occur. If perforation occurs an adherent scar (leucoma) remains.

The ulcerative process may be the result of an injury, with a foreign body as a nucleus, or it may result from severe conjunctival inflammation. Subjective symptoms are pain, aching in supra-orbital region and sometimes photophobia.

*Indolent Ulcer.*—A term applied to different forms of ulcers which are decidedly chronic in character, showing but slight tendency to heal. There is little or no pain, and the condition is often difficult to detect on account of lack of acute symptoms. Found in anemic and scrofulous persons,

and often also in trachoma. Probably depends upon faulty nutrition of the cornea through some nerve disturbance.

1. Shallow ulcer, usually central and extremely chronic.
2. Excavated ulcer, frequently seen in children. Has the appearance of having been cut out with a punch. Congestion often absent, not very amenable to treatment.
3. Reparative ulcer, sometimes found during the healing process of corneal ulcer. The haziness disappears, leaving a clear surface.

*Infecting or Sloughing Ulcer* (purulent keratitis).—This form of ulcer is characterized by almost total absence of reparative vessels, the morbid process spreading considerably from the starting point, and iritis and hypopyon complicating the disease. Usually the result of slight traumatism, and not infrequent in elderly people with faulty nutrition.

The most dangerous of these ulcers is the acute serpiginous or creeping ulcer of Saemisch. It starts as a nearly central gray area; this soon ulcerates, the margins being sharp, one margin assumes the form of an elevated curve, more opaque or yellow than the rest, and called the arc of propagation. Behind this the ulcer with its gray floor seems deeper than that next the corneal margin.

The corneal tissue surrounding the ulcer is opaque. The ulcer spreads rapidly, getting deeper, and threatening the integrity of the cornea. Iritis, iridocyclitis and hypopyon may result. Perforation of the cornea, as well as extensive sloughing of the corneal tissues, are likely to occur. The eye is extremely sensitive, and superciliary pain is often intense. Impairment of vision is marked and may be reduced to simply perception of light.

The disease is not infrequent among harvest hands, especially those who are poorly nourished, and more especially if there is a tendency to pus formation from slight abrasions of the skin. This will also hold in all individuals with this tendency.



**HYPOPYON.**—This condition may result from ulcers of the cornea, no matter what the size, and consists of a collection of pus in the anterior chamber. The amount may vary from just the suspicion of pus, to nearly enough to fill the chamber. It presents the appearance of a yellow mass at the bottom of the anterior chamber, bounded above by a horizontal or slightly curved margin. This mass will remain stationary or not, according to the fluidity of the material, in changes of position of the head.

When this combination of pus and ulcer exists it is called hypopyon keratitis.

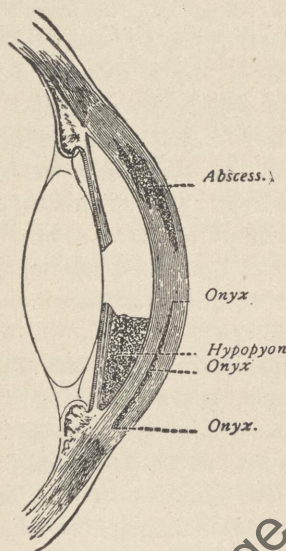


FIG. 29.—Norton.

**ABSCESS OF THE CORNEA.**—

This consists of a purulent infiltration in the deeper layers of the cornea. The epithelium over the abscess in the early stages is unbroken and prominent as a rule, but in the later stages it becomes discolored and slightly sunken. A hazy corneal zone surrounds the morbid point; hypopyon is present, the aqueous turbid, and iritic changes are noted.

The subjective symptoms may or may not be present, which attend other corneal lesions. A complete perforation of tissue may occur, or the process may subside by resolution.

*Causes.*—In many cases it is hard to ascribe any special cause,

the disease coming on without any previous history of traumatism or eye disease. Some writers ascribe such cases to a tubercular condition, the cornea being the point of infection. The disease has been found during or following scarlet fever, measles, typhoid fever, small-pox, or diseases which debilitate the patient excessively.

ULCUS RODENS (Mooren), Rodent Ulcer.—This is a superficial ulcer. As a rule commencing at the upper corneal margin. The normal corneal tissue is separated by an opaque gray rim, evidently undermined by the morbid process. This differentiates this form from all other forms. After a time the appearance is that of a clear surface, cicatrization commences and blood vessels appear. The morbid process seems to be subsiding, but relapses occur. Marked inflammatory action returning, and in time the morbid process invades the entire cornea. Perforation rarely if ever occurs.

The disease fortunately seldom occurs, but when it does it is found in elderly persons. Both eyes are affected as a rule, sometimes at the same time, but often an interval intervenes. In these cases the use of the actual cautery applied to the edges of the ulcer will often effect a cure, provided suitable constitutional measures are employed.

ANNULAR ULCER (circular ulcer, marginal ring ulcer).—This form appears as a deep groove near the corneo-scleral junction. The line of symptoms usually present in corneal lesions is not marked. The lesion may extend around the entire cornea, depriving it of nutrition. Perforation frequently occurs, and iritis is also often present. Most frequently seen in old persons or those with debilitated systems. The results of treatment are not satisfactory.

DENDRITIC ULCER (keratitis dendritica, herpes corneæ febrilis).—These ulcers are superficial and may spread over the corneal surface, either in the form of a large lesion extending in all directions, or in certain directions only. When it pursues the latter course the appearance is that of a branched shrub, frequently with nodes at the extremities of the growth, hence the name keratitis dendritica. (Emmert.) As a rule the symptoms attending keratitis are marked.

KERATO-MALACIA (exhaustion ulcer).—The corneal tissues soften and slough. This condition may occur either at the periphery or at the central portion. A large perforation



often results. The disease is found most frequently in badly nourished patients who have passed through illness impairing the nutritive powers. Also sometimes follows ophthalmia neonatorum.

*Prognosis of Corneal Ulcers.*—Depends upon the location, amount of tissue involved, general condition of patient, and the time the disease is seen. Some irregularity of corneal surface and opacity will result in nearly every case. In the severe forms the reduction of the vision is usually considerable. The tendency of many of the forms to recur must be borne in mind. The probable results of the lesion should be remembered, so that if the outcome is better than anticipated it will be all the better.

*Treatment.*—Locally, when the morbid process is near the center of the cornea, a solution of sulphate of atropine should be used to keep full mydriasis. Hydrobromate of scopolamine is also useful for this purpose, and does not seem to be so likely to produce conjunctivitis as the atropine solution. If the ulcer is near the periphery, sulphate of eserine should be employed, unless iritis threatens, in which case the atropine should be used twice a day, and the eserine two or three times a day. The mydriatic being used morning and night. As a wash the boric acid solution has the first place. The employment of Lloyd's hydrastis with the addition of sulphate of morphine will relieve the irritating features of the case, and also tend to keep conjunctival complications in abeyance.

Under no circumstances use cocaine in these cases, unless it is for the purpose of treating the ulcer, either by scraping or the application of some solution, as nitrate of silver, iodine or carbolic acid, but do not allow the patient to use the drug at all.

If there is much conjunctivitis in connection with the corneal lesion, the brushing of the conjunctival surface of the lids with a one-per-cent. solution of nitrate of silver will in many cases relieve the conjunctivitis.

Scraping the ulcer with a spud or curette, then touching the traumatic surface with a five-per-cent. solution of nitrate of silver, tr. iodine or carbolic acid will often change the morbid process, and cause healing to take place quickly. This procedure must be done under the influence of cocaine, and the utmost care must be observed not to injure healthy tissue with the instrument, and also that none of the solution used after the scraping, be allowed to touch any of the healthy tissue. Stimulating applications should never be used during the acute stage.

Internally the same line of treatment given under phlyctenular keratitis should be followed. The bowels should be made to move twice a day in these cases, as well as in all severe eye diseases.

In the subacute and torpid stages local stimulation should be resorted to. The yellow oxide ointment is a favorite with some. Finely powdered calomel has given good results in many cases, but care must be exercised not to use this drug if the patient is taking iodide of potassium, as an irritating conjunctivitis may result. Dusting boric acid into the eye has often been all that is necessary. Aristol has also been used in the same way with good results. Iodoform has been employed as well, and in some instances the result has been better than with any other agent. These preparations must of course be in as fine a state of subdivision as possible. Gentle massage of the cornea through the lid, using the finger as the means, should always be employed after the powder has been dusted over the cornea. The best and cleanest method of making the application of powder is to twist a little cotton onto the end of a cotton carrier in such a way as to make a brush, this dipped into the powder will hold enough so that by striking the carrier with the finger, a little of the powder will be loosened and drop onto the cornea. In this way no dirty brushes are employed and the danger of infection is reduced to a minimum.

In some of these cases, where the ulcer is indolent, and



the healing is not progressing as it should, the use of eserine will often cause a change in the process, and hasten recovery.

Paracentesis of the cornea may have to be performed in some cases, this will be required whenever the danger of perforation is imminent. Increased intra-ocular tension is also an indication in many cases, but as a rule the operation should not be attempted by the novice. Saemisch's operation is sometimes performed in these cases also. (See operations.)

A bandage is sometimes a necessary requirement, especially if danger of perforation is present, but as a rule more damage is done by retention of the secretion under such measures, than if the eye was covered with simply a shade.

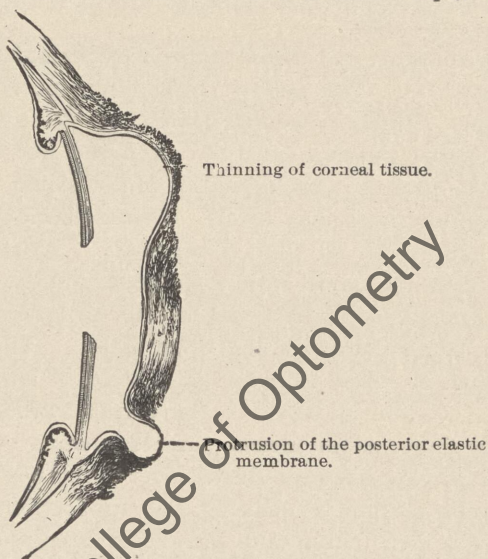


FIG. 30.—Staphyloma of Cornea.—*Juler.*

If hypopyon is present and the pus is not in large quantities it can be absorbed in many cases, but if profuse, paracentesis may be required to evacuate it.

If perforation occurs, solutions of atropine or eserine must be used persistently according to the location of the perfo-

ration. If possible, by gentle manipulation, the prolapsed iris should be replaced, after which a well adjusted compression bandage should be applied, and the patient required to keep in the recumbent position.

When there is considerable prolapse of iris, or if it is found impossible to replace a smaller one, and but two or three days have elapsed since the accident, the protruding portion should be grasped with a forceps, the iris drawn forward and excised close to the cornea. After this operation a conjunctival flap may be taken from the ball, having it at least twice as large as the perforation, and inserting it into the opening with a probe. No undue force should be exerted, all manipulations being made with the utmost gentleness. A compression bandage should then be applied. Anterior synechia nearly always results from perforation no matter what the size or treatment. Staphyloma will often follow if the amount of corneal tissue implicated is considerable, in spite of all measures.

CONDITIONS COMPLICATING CORNEAL LESIONS.—*Conjunctivitis*.—This should be treated similarly to conjunctivitis without corneal ulceration. Perverted cilia are often found in this condition, and they should be removed. Many cases are not only aggravated by misplaced or dead lashes, but also by keeping up a constant irritation may continue the morbid process. The examination of the ulcer for the presence of a foreign body should be made a matter of routine. Diseases of the lachrymal duct and sac should be treated, the passage being washed with a solution of boric acid in order to keep unhealthy secretion from passing backward, and causing additional danger to the eye.

The teeth should be examined, and if any faulty condition is found, refer the case to a good dentist. The condition of the nasal and pharyngeal mucous membranes should be repeatedly noticed, and any wrong treated. The alimentary canal should also receive a due amount of attention.



*Sequelæ.*—Ulceration of the cornea always leaves more or less opacity. When it is slight the term *nebula* or *macula* is used; when dense *leucoma*.

As a result of the ulceration the refractive surface of the cornea is irregular, producing distortion of the image on the retina, and this may be one of the causes of irregular astigmatism. The location of the ulcer also is of prime importance in determining the amount of visual disturbance, the nearer central the greater the defect.

Entanglement of the iris in a perforating ulcer is called *anterior synechia*; the scar to which the iris is fastened is called *adherent leucoma*. This condition may never give the patient any trouble, but it may furnish the exciting factor for repeated inflammations, eventually causing sympathetic irritation of the other eye.

The term *corneal staphyloma* is given when there is protrusion of the cicatrix with iritic attachment; this is total when the entire cornea is involved, partial if only a portion is affected.

*XEROTIC KERATITIS (Necrosis Corneæ).*—A disease of children, usually under two years of age. There is not only ulceration of the cornea, but also a dry condition of the conjunctiva.

*Causes.*—Subjects of mal-nutrition seem most susceptible. Has been noted in conjunction with variola, meningitis and measles. Poor hygienic surroundings seem to have an influence.

*Symptoms.*—Lachrymation and congestion of the conjunctiva. A hazy condition soon appears in the cornea followed in a very short time by ulceration. Iritis and hypopyon usually follow. The cornea may be perforated and extensive destruction of the corneal tissue ensue. Usually both eyes are affected, but not simultaneously.

*Prognosis.*—Bad. Death often results from the physical condition which seems to produce the disease.

*Treatment.*—It does not vary from that already described.

**NEUROPATHIC KERATITIS** (Neuro-Paralytic Keratitis).—Characterized by anesthesia of the cornea. This results from morbid conditions of the nuclei or ophthalmic branch of the fifth nerve. The inflammatory action begins in the corneal tissue, there being infiltration at the affected points. This eventually forms an ulcer, which if neglected, becomes extensive, perforation of the cornea and prolapse of the iris following. Hypopyon, or a mixture of pus and blood may form in the anterior chamber.

*Causes.*—Disease or injury of the fifth nerve, or its nuclei, disease of or removal of the Gasserian ganglion. Injuries or disease of the orbit, or fracture of the skull may affect the nerve and produce this disease.

*Symptoms.*—The usual line of symptoms of keratitis may be present, but may be absent. Anesthesia of the cornea should be remembered as a diagnostic feature.

*Prognosis.*—Guarded. If seen before extensive changes have occurred the chances for a favorable outcome are much better than when seen later.

*Treatment.*—Atropine or eserine locally, combined with scrupulous cleansing of the eye. No irritating collyria should be employed. In some cases the eye should be kept closed, but care must be exercised if a bandage is applied not to have it press against the eyeball. As a rule constitutional treatment does not vary from that already described under corneal ulcers.

**HERPES CORNEÆ.**—A condition frequently associated with herpes zoster ophthalmicus. Small, roundish vesicles filled with serum appear upon the cornea, which soon break down and form ulcers. Denudation of epithelium somewhat like that produced by an injury is the appearance presented. The vesicles are arranged in a circular form, or pass across the cornea in a line. The pain during the onset is severe, and neuralgic in character. After the vesicles rupture and the epithelium is shed, an excoriated surface remains, the



edges being irregular. At this period the pain is little or none.

The healing process is slow, and is likely to be interrupted by a fresh outbreak of vesicles. Hypopyon may come on as well as iritis. Pain in the eye and superciliary region, photophobia, lachrymation, and the sensation of sand or dust in the eyes constitute the general line of symptoms.

*Treatment.*—Not very satisfactory. Locally the use of atropine. The ointment of boric acid will often afford relief. After the formation of the open sore or ulcer, eserine will be useful unless iritis is present.

Internally, such drugs as will restore nutrition may be used. For the neuralgic pain, liquor potassii arsenitis in doses of gtt. ss every hour will often give relief. Fluid ext. piscidia erythrina gtt. v to xv every two or three hours has also given relief in some cases. Full doses of sulphate of quinine is sometimes indicated.

**KERATITIS BULLOSA.**—Seems as a rule to make its appearance in eyes whose nutrition has been interfered with. Often seen in connection with glaucoma, interstitial keratitis, or irido-cyclitis. Malaria has also been given credit with causing the condition, while cases occur in which it is impossible to assign any cause. "The nature of the disease is not known; the best presumption is that some disease of the corneal nerves is at the bottom of it." (Fick.) According to Fuchs there is an abnormal lymph circulation, stasis taking place, edema of the cornea results, and a blister-like elevation is formed by the fluid lifting the epithelium from Bowman's membrane.

A bleb is formed which is filled or partially filled with fluid, which produces distension of the lower portion of the bleb.

*Symptoms.*—Burning pain, photophobia, pericorneal injection, and often congestion of the entire ocular conjunctiva. The pain is usually paroxysmal. After the bleb breaks, which, as a rule, occurs in a few days, the pain subsides,

but there is a large abraded surface which forms an ulcer. Recurrence is frequent, and each time the severe inflammatory action is repeated.

*Treatment.*—If glaucoma is not present or feared, the use of atropine may give relief. Eserine should be used where glaucoma is feared or is a factor. Puncture of the bleb may give relief from the acute stage. Heat may be beneficial in some cases. The boric acid wash may be used and will help cleanse the tissues. Internally, during the forming stage, aconite should be given. When the pain is of a burning character rhus tox. is indicated. If there is a history of periodicity (malaria) full doses of sulphate of quinine, followed by liquor potassii arsenitis. If the ulcer does not seem to heal readily the use of formalin 1-60 is recommended, as well as the actual cautery. Dusting the surface with iodoform is also recommended.

**VASCULAR KERATITIS.**—A superficial vascular condition of the cornea, with an opaque condition of the tissues. This is seen in the pannus caused by trachoma, and also in some cases of recurring phlyctenular keratitis. Entropion may also cause this condition.

There is a form of vascular keratitis, in which the disease starts on the upper and lower margins of the cornea, approaching each other until the entire cornea is invaded. In these cases both eyes are affected, here it seems to be an affection of the nerves of the cornea, nutrition being interfered with. It is found in scrofulous children, or those having a perverted nutrition. Blood-vessels and capillaries are present.

*Symptoms.*—If the condition should be acute, there will be photophobia, lachrymation, conjunctival and sub-conjunctival congestion, and ciliary neuralgia. In the chronic form which is the most common, the disturbance is slight. There will be a feeble protest against strong light, and at the upper border of the cornea a crescent of blood vessels, which ad-



vance on the cornea, pushing an opacity before them. Unless the disease is the result of trachoma, entropion or trichiasis, when the upper border alone is affected; there will be another formation at the lower border similar in appearance. These will gradually approach each other until they meet. The clearing process commences at the border also, the center being the last to clear. The clearing process seldom is perfect, more or less roughness of the corneal epithelium remaining.

Ulcers may appear, but, as a rule, this does not occur.

*Prognosis.*—Unfavorable in chronic cases. In recent and acute cases the results are generally more favorable.

*Treatment.*—Locally all irritants are contra-indicated, as they will aggravate the case. If possible find the cause of the trouble, and when it is amenable to treatment the results will be all the better. Atropine should be used if there is a tendency to iritic trouble. Eserine seems to favor the reparative process, but must be carefully employed on account of the tendency to iritis. The use of the douche, as already directed, will give favorable results in many cases. The health of the patient must be carefully looked after. Hygienic conditions improved if possible, plenty of open-air exercise, not carried to the point of fatigue, however. Internally the use of aconite during the progressive stage. Rhus tox. with burning, and motion increasing the discomfort of the patient. Jaborandi when the clearing stage sets in. Calcium in some form is indicated in nearly all cases. Iodide of arsenic 1-200 gr. doses in anemia and also where the nutritive powers seem sluggish. Phytolacca with enlarged lymphatic glands. Iris versicolor with glandular involvement and a specific history. Iodide of potassium with a syphilitic history. In fact, any drug that seems to be indicated by the patient's general condition will help the eyes.

INTERSTITIAL KERATITIS (Syphilitic, Inherited, Parenchymatous, Strumous, and Diffuse Interstitial Keratitis).—A hazy

condition of the entire corneal tissue, the result of chronic inflammation, seldom any ulceration, but a superficial or deep vascularization always present.

*Causes.*—In the majority of cases due to hereditary syphilis and is seen most frequently between the ages of five and fifteen, sometimes in younger individuals, and but seldom after thirty. It may also result from acquired syphilis, but these cases are rare.

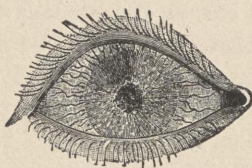


FIG. 32.—Interstitial Keratitis.—Hansell and Bell.

Rachitis, scrofula, rheumatism, gout and perverted nutrition may also be causes of this disease. In the female the approach of puberty seems to aggravate the disease, but after the menstrual function is established the condition often improves. These are cases that undoubtedly develop the affection *in utero*.

The statement is frequently made that girls are more often subjects of this disease than boys. This may be true in one respect, as boys are more likely to be engaged in active outdoor exercise, and as specific disease is generally acknowledged to be eliminative, this activity would have a tendency to reduce the percentage of boys afflicted with interstitial keratitis.

*Symptoms.*—If noticed early there will be found slight ciliary congestion and lachrymation, followed by slight cloudiness, generally near the center of the cornea. Careful examination of these spots by oblique illumination will show them not to be on either surface of the cornea, but in the substance proper. The point of infection may however be near the periphery, and follows the same course of invasion as when central. In a few weeks the haziness will spread



over the entire corneal structure, and may be so dense as to make an examination of the iris impossible. "Ground-glass appearance" is a term applied to this condition. The haziness is not uniform as a rule, but points of deeper infiltration will be noticed, and are called "centers of the disease." This is best observed by oblique illumination. Pain and dread of light are usually present in varying degrees.

Blood vessels derived from the ciliary vessels are numerous in the layers of the cornea and produce a dull red color, "the salmon patch" of Hutchinson.

These patches may be multiple and small, or may cover the entire corneal surface, which then presents a cherry red color.

Strumous children, who are also syphilitic, will be found more irritable, and with a corresponding increase of photophobia. Ulceration seldom occurs, but iritis is not an infrequent complication. Inflammatory action may attack the ciliary region; secondary glaucoma may result, and also shrinking of the eyeball.

Disseminated choroiditis, retinitis, retinal hemorrhages, and optic neuritis have been reported in these cases.

The general appearance of the patient should be taken into consideration, as it will often lead to a correct diagnosis, when no amount of questioning will elicit any information. Dwarfed stature, skin flabby and coarse, bridge of nose sunken, scars at angle of nose and mouth, mal-formed permanent teeth, the central incisors have vertically-notched edges (Hutchinson's teeth). Enlarged lymphatic glands, especially of the neck, these being small, hard and painless, without a tendency to suppuration, which differentiates them from the enlarged glands of scrofulous subjects. Deafness, cicatrices in the pharynx, chronic periostitis of the tibia, synovitis of the knee-joint, all show a specific taint. I have noticed in a number of cases, especially of the second generation, that there is a decided tendency to "knock-knee."

Proper treatment and time will, in many cases, give a

fairly clear cornea, although normal transparency probably never returns.

*Diagnosis.*—Seldom difficult if the foregoing conditions are borne in mind. The tension of the eyeball and age of the patient help exclude glaucoma. The history and character of the inflammation distinguish it from old corneal maculæ and diffuse infiltration, which sometimes results from traumatism. If small, straight vessels are present it is usually the result of a former attack.

*Prognosis.*—Unfavorable, as both eyes are more than likely to be affected, and a return to normal transparency of the tissues seldom if ever occurs. Relapses are frequent, even with the best of treatment and care, and it is almost impossible to cut the progress of the disease short. It may be from three months to three years developing, although either extreme is the exception. When clearing does commence it is at the periphery and clears toward the center of the cornea.

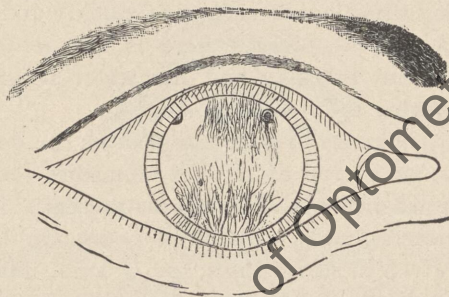


FIG. 33.—Vessel formation in the cornea after interstitial keratitis.

The chances of permanent changes in the deeper structures of the eye must be kept in mind, as changes in the choroid or retina may occur in the macular region, impairing vision to a considerable degree. The nerve may also be affected, and recurring iritis or cyclitis is not infrequent.

*Treatment.*—Good hygiene is of the first importance. This, of course, includes proper food, open-air exercise,



clothing, etc. Irritating applications are positively harmful. If the maculæ are so dense that a view of the iris cannot be obtained, the use of atropine as a routine measure should be employed; this may prevent iritic complications. The tension of the eyeball must be watched, however, as an increase may be the signal of glaucomatous action, when eserine will have to be used until this condition passes off. The eyes should be protected from bright light, but it is better to give them the advantage of moderate light. If severe inflammatory action supervenes the application of heat may be required, but more reliance should be placed on internal medication in this condition, as well as for the usual course of the disease. An ointment of sulphate of atropine, gr.  $\frac{1}{4}$  to 3 ij, will often prove grateful to the patient, and will give the action of the drug as well as the solution. The Lloyd's hydrastis and morphine, in a solution of boric acid, will be a good collyrium in these cases. The use of the leech and blister I do not approve of under any circumstances. A good, brisk cathartic will relieve as quickly and the effects are more permanent, besides there is not another lesion to watch. Corneal massage and hot water irrigation will be beneficial during the resolution stage.

Internally chloride of gold and sodium in doses of 1-200 gr. to 1-100 gr. is one of the best remedies for combatting this disease when the specific taint is present. Iris with the small indurated glands. Iodide of potassium in these cases should be given in small doses, gr.  $\frac{1}{4}$  to ss, unless the case is one of acquired syphilis when full doses are necessary. If there is active inflammatory action, with a specific history, the use of corrosive chloride of mercury or red iodide of mercury, gr. 1-200 to 1-100, will be found better treatment. Under these conditions small doses of aconite should be given. Phytolacca should be employed in those cases especially having scrofulous complications. In these cases liquor potassii arsenitis, gtt.  $\frac{1}{4}$  to ss, or sulphide of calcium 1-100, will be better treatment than either the gold or potassium,

unless the disease is a complication of the two taints. Calcium is a remedy not to be forgotten in these cases, as the addition of the lime salts appears to have a direct influence in building up not only the glandular system but muscular as well. Jaborandi gtt.  $\frac{1}{4}$  to j is especially useful in promoting absorption in these cases after resolution has commenced. If there is a rheumatic tendency and motion increases the pain, bryonia gtt.  $\frac{1}{4}$  to  $\frac{1}{3}$  should be given. If quiet increases the pain rhus tox. gtt. 1-15 to 1-10 is the drug. With a sensation of bruised tissue cimicifuga gtt.  $\frac{1}{4}$  to ss will give prompt relief. The use of bichromate of potassium, 1-100 gr. doses in those cases having a tenacious secretion, will relieve, and sometimes the clearing process seems to be materially improved by the use of this drug. The indicated remedy will always prove beneficial in these cases. The bowels must be kept in good condition and must be carefully watched, especially when atropine is being used, as this drug has a tendency to produce constipation.

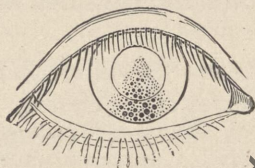


FIG. 34.—Punctata Keratitis.—Hensell and Bell.

**KERATITIS PUNCTATA** (Punctata Keratitis).—A condition in which there is a deposit upon the posterior corneal surface, triangular in form and having the appearance usually of reddish sand. The apex being toward the pupil and the base at the lower margin of the cornea. This condition usually is the result of irido-cyclitis, there may be some implication of the corneal tissue proper, but this seldom occurs.

*Causes.*—Probably due to syphilitic taint. In many cases either irido-cyclitis or cyclitis are the active causes of this disease.



*Prognosis.*—More or less diminution of vision probably always present.

*Treatment.*—See Serous Iritis.

**KERATITIS PROFUNDA** (Circumscribed Parenchymatous Keratitis).—A form not often seen; ulceration does not occur. There is a hazy condition of the corneal tissue, which often is unattended by marked symptoms. Hyperemia of the iris may be present.

*Causes.*—An injury, rheumatism, malaria so-called, or a severe cold may be causes, but usually no definite cause can be assigned.

*Symptoms.*—As already stated the usual line of symptoms of keratitis may be lacking, but in some instances inflammatory action may give rise to the usual line seen in other forms of keratitis.

*Prognosis.*—The opacity may be permanent, or slowly be absorbed, leaving a comparatively clear cornea.

*Treatment.*—A mydriatic is indicated in nearly every case. Other local or constitutional measures will be found under previous headings.

**KERATITIS PUNCTATA SUPERFICIALIS.** This condition seems to resemble herpes of the cornea, but there is slight tendency to formation of ulcers. Occurs in young persons and usually both eyes are affected. In the majority of cases there will be disease of the nasal or pharyngeal tissues.

*Symptoms.*—An acute conjunctivitis, catarrhal in character. In a few days the corneal surface appears to be irregularly covered with gray points, the intervening cornea being hazy; these points are situated beneath Bowman's membrane.

*Prognosis.*—The cornea may not clear perfectly, but the resulting vision is generally good. The disease is essentially chronic, so it will take considerable time to effect a cure.

*Treatment.*—The condition of the nose and throat must be looked after. A mydriatic is generally required during the earlier stages, and later the indications for drugs must be watched for.

**KERATITIS MARGINALIS.**—A condition sometimes seen in elderly persons, where there is a yellowish or yellowish gray corneal opacity, the exudation extends to the scleral margin. Inflammatory action is usually severe, after several weeks the inflammation subsides, the opacity lessens leaving a gray border joined to the sclera ; this distinguishes it from arcus senilis. Ulceration does not occur.

**SCLEROSING KERATITIS.**—A term applied to a more or less triangular opaqueness of the cornea, the apex located in the cornea and the base evidently in the contiguous sclera. This condition is more or less permanent. There may be recurring attacks involving different portions of the corneal margin. It is essentially a disease of old age.

*Treatment.*—Same as in scleritis.

**RIBBON-LIKE KERATITIS (Transverse Calcareous Film).**—Most frequently seen in the aged. There is an oval shaped opacity in the cornea, sharply outlined and free from any tendency to ulceration. It consists of salts of lime and resembles very closely the appearance of the lead deposits which are seen occasionally after the use of a solution of acetate of lead in the eye where corneal ulcerations are present. The deposit can usually be chipped off. Acute conditions are seldom excessive. Uric acid and gout have been credited with producing this lesion. In one case, a young girl, however neither of these conditions would account for the deposit and no cause could be assigned.

A type sometimes found in eyes blind from irido-cyclitis, glaucoma, or sympathetic ophthalmia is where there is an illly defined margin, the color having a brownish cast and situated on the lower third of the cornea. This form is seen in cases with impaired nutrition. Treatment does not seem to produce much effect in these cases.

**ARCUS SENILIS (Gerontoxon).**—This is not a diseased condition, but is nearly always found in old persons. It consists of an arc, gray in color, which is formed by a deposition of colloidal substance in the upper layers of the cornea. In true



arcus there is always a narrow clear ring of cornea between the band and sclera. It commences in the upper margin, soon followed by a similar one in the lower margin, these extend until the arcs unite forming a ring around the cornea. The outer boundry is sharp and clearly defined, on the inner side however the band shades away into the clear cornea. No treatment is required.

CONICAL CORNEA (Keratoconus).—A bulging forward of the cornea, cone shaped, and seldom congenital. The center of the cornea is thinned, and through intra-ocular pressure is pushed forward. If the amount is slight it may not be noticed unless the shadow test is used. The cone is transparent as a rule, but the apex may be slightly opaque. The formation may increase in size for years before it comes to a stop. Ulceration or rupture does not follow in these cases. Usually both eyes are affected. Myopia and astigmatism always follow.

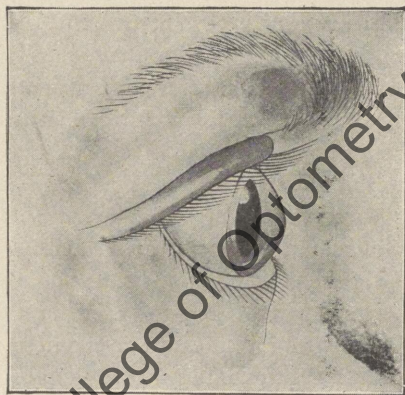


FIG. 35.—Conical Cornea.—Fick.

Seen most frequently in women, and seldom before the age of fifteen. It has been found to follow exhausting illnesses, but none of them can be positively assigned as causes. Probably impaired nutrition of the cornea following these diseases with disturbances of intra-ocular pressure is a factor.

*Treatment.*—If the disease has not progressed too far, some benefit, as far as vision is concerned, may be obtained from the use of glasses, but the improvement is usually slight. Different operative measures have been advised, but none of them have given brilliant results. In the early stages the use of eserine has seemed to improve, not by reducing the cone already formed, but by relieving the intra-ocular tension, and holding the bulging in check. The use of jaborandi in these cases should also have a similiar effect, as the drug will relieve increased tension in many cases. Attention to the general health should be insisted upon.

**TRAUMATIC KERATITIS (Injuries of the Cornea).**—This form of keratitis may result from various causes.

**FOREIGN BODIES.**—Any substance which becomes lodged upon or in the cornea may produce a keratitis. Sand, cinders, emery, chips of iron, spines of the chestnut-bur, spines of thistle; in fact, almost any substance small enough may at times be found in the corneal tissue.

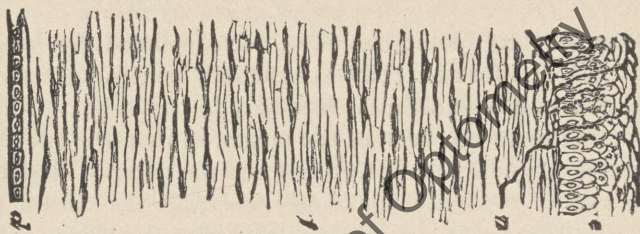


FIG. 36.—Vertical section of rabbit's cornea.—Kirke.

n, Nerves forming a delicate subepithelial plexus, and sending up fine twigs between the epithelial cells to end in a second plexus on the free surface.

The pain is usually severe, and the location of the intruder is usually referred to the upper lid. The eye soon reddens and the flow of tears is excessive. The eye should be carefully examined by good illumination, and when the body is discovered, if embedded in the corneal substance, no effort should be made to remove it until the eye has been rendered tractable by the instillation of a solution of cocaine. As soon



as the eye is insensitive to pressure with a probe, the lids should be separated by means of the thumb and forefinger of one hand, and holding the spud or needle with the other, lift the body from its quarters without injuring the surrounding tissue, if possible. If the object is very deeply embedded, it may be necessary to give a rotating motion to the spud before the removal is successful. If the body seems to be loosely embedded it can often be wiped away by means of a wisp of cotton on some light instrument, brushing the cotton carefully across the object. After the removal of the foreign body the surface should be carefully examined by means of oblique illumination to be sure there is no remaining particle. The upper lid should also be everted, as sometimes the body will be broken into several pieces, some of which may be found sticking into the conjunctiva of the upper lid.

Iron or emery will nearly always leave a small rust-colored spot or stain, which cannot always be removed, although this stain has in some cases caused an ulcer to form at the seat of injury. The removal of powder grains by means of a fine galvano-cautery point has been recommended by several writers. If a foreign body has partially penetrated the corneal tissues it is sometimes necessary to pass a broad needle through the cornea back of the object, so that the efforts at removal may not push it through into the anterior chamber. Small splinters of steel sometimes penetrate the cornea and lodge on the iris or lens, or may drop into the anterior chamber. Their removal is attended with considerable difficulty. The best method is an electro-magnet; care must be exercised, as more damage may be done than the presence of the foreign body itself. Cases being not infrequent where no untoward results ensued, even after the lapse of years. If no infectious material has been carried into the eye with the body it will be better to let it alone than to make unjustifiable attempts at its removal. Copper or brass splinters however are always a menace to the eye and should be removed as soon as possible.

After the removal of a foreign body, if there has been much abrasion of surface, the instillation of a drop of atropine solution will quiet the irritation, and the use of the boric acid wash will be all that is necessary in the majority of cases. If a corneal ulcer forms it should be treated as already given under this head.

**EROSIONS.**—Superficial loss of epithelium, caused by contact with a sharp body. The finger nail is not an uncommon cause of this condition. The careless use of the eye-dropper has also been the cause of erosions. If septic infection occurs a severe ulceration of the cornea may result.

*Treatment.*—The wash of boric acid used every hour, and the collyrium of hydrastis, will be all that is necessary in the majority of cases, unless ulceration ensues.

Wounds of the cornea naturally divide themselves into penetrating and non-penetrating. The character of the wound varies according to the instrument inflicting the traumatism. Penetrating wounds are the most dangerous, as they allow the aqueous to escape, and in this way the iris is liable to be incarcerated in the wound. The lens may also be injured, causing traumatic cataract. The intruder may enter the vitreous chamber, causing the total loss of the eye. The ciliary body may be injured, in which case the liability of sympathetic inflammation of the other eye is increased.

*Treatment.*—In perforating wounds, if there is prolapse of the iris, it should if possible be replaced and atropine or eserine used, depending on the location of the rupture. If impossible to replace the iris, the protruding portion should be grasped with forceps and excised. Rest, cleansing of the eye with boric acid solution, application of iced cloths, and internally veratrum viride gtt.  $\frac{1}{3}$  to ss. If iritis results the use of atropine is necessary.

If the wound is severe, involving the cornea, iris, lens and ciliary body, the question of enucleation or evisceration must be decided upon.



**KERATITIS FILAMENTOSA** (Filamentous Keratitis).—Seldom seen. Minute tissue threads seem to develop from corneal abrasions. These threads result from active epithelium proliferation. They may persist or disappear spontaneously. In some cases there is recurrence after removal.

**BLOOD-STAINING OF THE CORNEA.**—A rare affection. The periphery of the cornea remaining clear, but the central portion presents a rusty or smoky tinge. The line of demarkation is clearly defined. May be found in cases of increased tension and hyphemia. This has been mistaken at times for a dislocated lens in the anterior chamber. The discoloration may disappear, leaving a clear cornea, but two or three years are required for this process.

*Treatment.*—Simply to correct any known errors.

**CORNEAL TUMORS.**—Very seldom seen and are usually the result of corneal invasion from contiguous tissues. Epithelioma, sarcoma, papilloma and fibroma tumors have been described.

Dermoid tumors sometimes occur and are congenital. There may also be other anomalies of the eyes or lids present. The growths may be found both upon the conjunctiva and cornea, usually on the temporal side. The appearance is that of skin covering a small, firm mass; hairs are found covering part of the tumor; these may be short and fine, or may be quite long. If left alone they may grow to considerable size.

*Treatment.*—Extirpation of the mass. This can often be done under cocaine anesthesia. It is best to close the traumatism by loosening the conjunctiva and approximating the edges as much as possible.

## CHAPTER VI.

### DISEASES OF THE SCLERA.

---

The sclera, or about five-sixths of the posterior external tunic of the globe, consists of firm unyielding membranous tissue, which gives and maintains the form of the eyeball.

The outer surface is white and smooth, excepting at the insertion of the external ocular muscles; the exterior portion is covered by the conjunctiva. The inner surface is brown in color, and contains grooves in which the ciliary nerves are lodged. The fine cellular tissue, (*lamina fusca*) connects the sclerotic with the outer surface of the choroid.

At the back and a little to the nasal side, the optic nerve enters the eyeball, through the optic foramen or canal of the sclera. The dural sheath of the nerve becomes continuous with the sclera at the point of contact and the connective tissues of the bundles of the fibers (perineurium, endoneurium) forms a net work, which stretches across the canal, and is continuous with the sclera. This net work is called *lamina cribrosa*.

The fibers of the optic nerve pass through this perforated tissue, losing their medullary sheaths, as a rule, but sometimes this does not occur, and a condition termed "opaque nerve fibers" presents. As a rule there is one large opening in this lamina, situated in the center, termed the *porus opticus*, which transmits the *arteria centralis retinae*. The ciliary vessels and nerves enter the eyeball through numerous minute apertures which surround the cribriform lamina.



SEMI-DIAGRAMMATIC HORIZONTAL SECTION THROUGH EYEBALL AND OPTIC NERVE. (After Ellinger. Reduced and altered.)

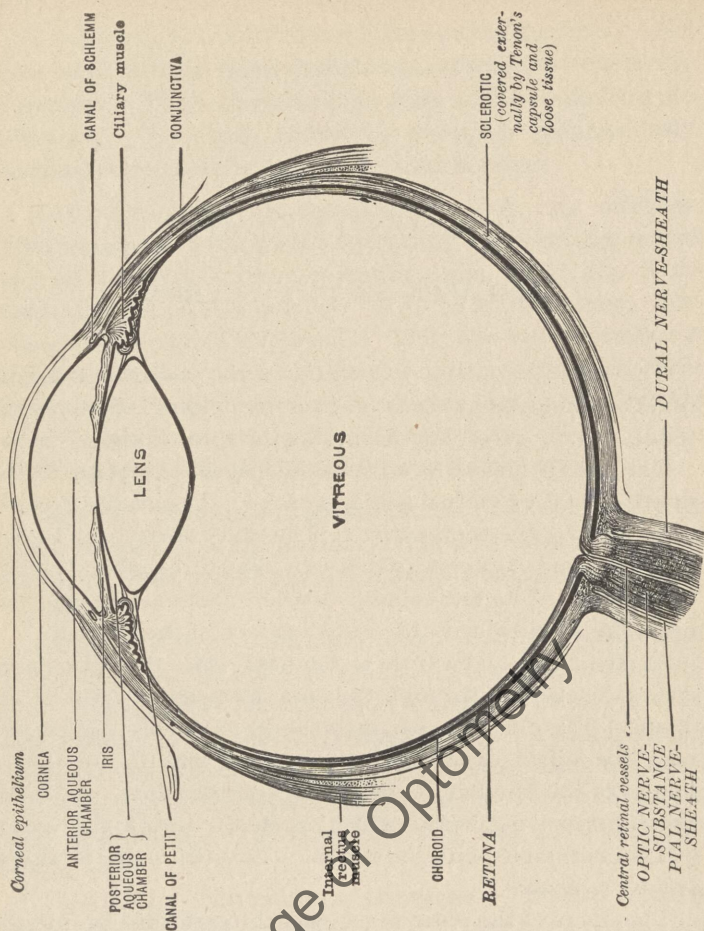


FIG. 27.—*Morris' Anatomy.*

While the sclera is traversed by vessels and nerves entering into the interior of the eye ball, it contains very few vessels itself, while the loose connective (episcleral) tissue covering the sclera and connecting the conjunctiva with it, contains many vessels.

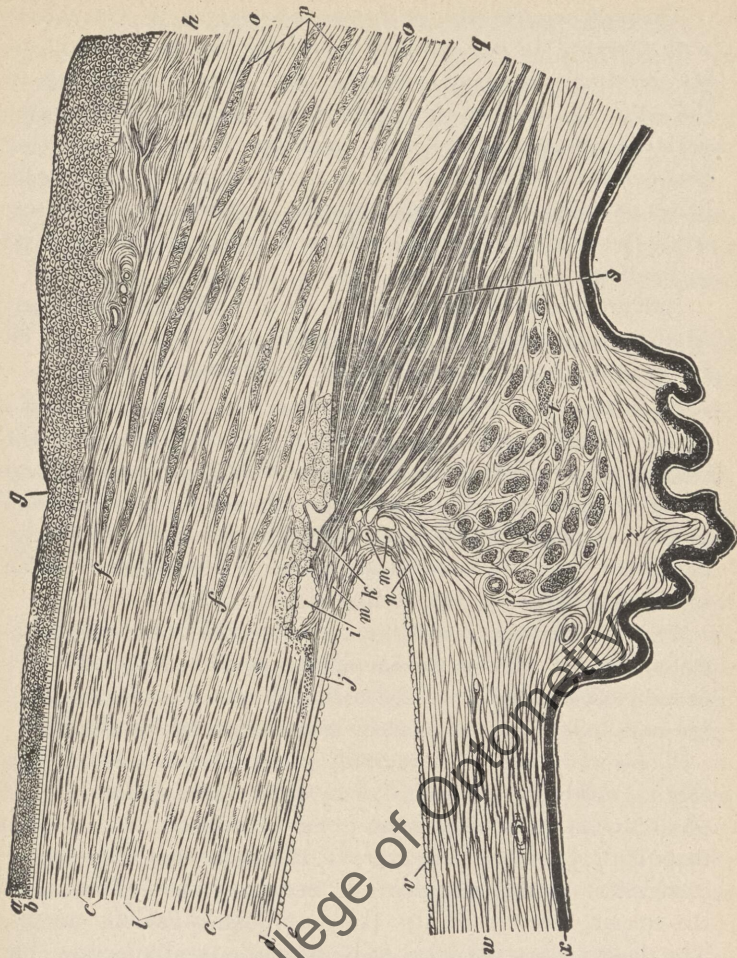


FIG. 38.—Antero-posterior section of the cornea with the sclera.  
Hansell and Bell.

a, Section corneal epithelium, b, Bowman's membrane, c, Corneal corpuscles, l, Corneal lamellæ (the whole thickness lying between b and d is the substantia propria cornea), d, Descemet's membrane, e, Endothelial layers, f, Junction of the cornea with the sclera, g, Limbus conjunctivæ, h, Conjunctiva, j, Canal of Schlemm, k, Leber's venous plexus (as regarded by Leber as belonging to l), m, Meshes in the tissue of the ligamentum iridis pectinatum, n, Attachment of the iris, o, Longitudinal, p, c, regular (divided transversely) bundles of fibers of the ciliary muscle, u, Transverse section of a ciliary artery, v, Endothelium of the iris (a continuation of that on the posterior surface of the cornea), w, Substance of the iris, x, Pigment of the iris, z, A ciliary process.



Through continuity of tissue, the sclera is continuous with the anterior one sixth of the globe, the cornea, and by the pectinate ligament with the iris. The inner portion of the sclera throughout its entire surface, is in intimate relation with the choroid. The close anatomical relation existing between the sclera and important tissue adjacent, often establishes pathological changes through extension of diseases, while the sclera is subject to inflammatory conditions peculiar to itself as well.

Inflammation of the sclera, is usually divided into superficial (episcleritis), and deep (scleritis). This may be divided into acute, chronic, diffuse or circumscribed.

EPISCLERITIS.—This is a circumscribed inflammation of a dusky red, sub-conjunctival swelling, situated usually in the ciliary region, on the temporal side, though it may appear on other portions. The size of the affected area varies from a good sized pin head to a lentil, there is more or less bulging of the tissue on account of exudative deposits at the point of inflammation.

The conjunctival vessels over the morbid processes are injected and movable in the edematous conjunctiva. The injected vessels in the episcleral tissues however are immovable, the nodule is hard and sometimes sensitive to the touch.

There is usually a dull aching pain, which is seldom neuralgic, although frequently severe. Lachrymation and photophobia are often present, or easily induced. It is seldom that both eyes are affected at the same time, the disease however is usually recurrent. There may be implication of the cornea, iris, or ciliary body, but this seldom occurs. The disease does not seem to be purely a local affection, but evidently depends upon some systemic disturbance.

Syphilis, gout, and rheumatism, have all been ascribed as factors, the latter being not infrequently associated with episcleritis.

*Diagnosis.*—Usually not difficult, although phlyctenular conjunctivitis may be mistaken for it during the early stages.

In episcleritis however, the injected blood-vessels are immovable and the disease seldom occurs in childhood. In phlyctenular conjunctivitis the vessels move with the conjunctiva, the center of the phlyctenule if large is often of a whitish-yellow color, and is oftener seen in children than in adults.

*Prognosis.*—In so far as disturbance of the vision is concerned, it is favorable. The final outcome is also good, but the length of time required for the subsidence of the disease should be guarded.

*Treatment.*—Local measures are of little avail, sulphate of atropine combined with sulphate of morphine may in some cases afford relief, and will prevent the use of the eyes, which nearly always aggravates the discomfort.

Hot, dry applications may also at times prove grateful, but care must be exercised in the use of moist heat, as a poultice effect may result, doing more mischief than the original disease.

Constitutional measures will usually give the most prompt results, but the disease seems to be essentially sub-chronic in character. In the early stages aconite is usually indicated; when the eye feels bruised cimicifuga. Pain increased by motion, bryonia; pain relieved by motion, rhus tox. When, as often presents, there appears to be a lack of activity of the mucous glands, jaborandi; colchicum when there is a rheumatic, gouty condition. The salicylates occasionally prove beneficial in the rheumatic type. If syphilitic conditions are present the administration of the iodides is usually indicated.

**ACUTE HYPEREMIA OF THE SCLERA.** (*Scleritis Periodice Fugax*).—This is a rare condition, the hyperemia lasting from a few hours to three or four days; there is usually more or less pain, and lachrymation is profuse. The condition may be mistaken for iritis, but examination shows the iris and cornea normal, edema of the lid is often present; no cause for the disturbance can be found, and one of the un-



pleasant features is the disposition to recur ; this may be but a few weeks apart or months may intervene, it is seldom both eyes are affected at the same time.

Disturbance of the vaso-motor or sympathetic system may be causes. The climacteric has been observed to have an influence. Rheumatism, gout and syphilis also seem to have an effect on this condition. Uterine disturbances may also be a factor, and the ocular muscles have received their due share of attention. The sclera proper is not affected.

*Treatment.*—Local means have little if any effect. The general health must be looked after and such remedies employed as are indicated.

ANTERIOR SCLERITIS.—Inflammation of the scleral tissues may occur independently of diseases of adjacent structures, and when this is the case the area affected is usually small and presents a bulging, thin, bluish elevation, generally situated over or near the ciliary region. The nodules generally multiple, usually form a broken ring around the superior corneal margin, they may subside without leaving a staphylomatous condition, but if the thinning of the sclera is considerable an anterior staphyloma results. If this does occur there is usually pain of a neuralgic character, increased lachrymation and symptoms of cyclitis or iritis appear. Occasionally the disease is more chronic in character and the symptoms are less severe. If the nodules are situated at the sclero-corneal margin, the cornea is implicated and sclerokeratitis results. The ciliary body is affected in nearly all cases, and at times it is difficult to determine whether cyclitis or scleritis is the primary disease. There appears to be no tendency to panophthalmitis when the sclera is the primary seat of the disease. Macroscopic deformity of the eyeball does not always follow, but change in the curvature of the cornea results (*astigmatismus acquisitus*).

So-called gumma of the ciliary body may be mistaken for this condition, but it lacks the bluish discoloration, being red and fleshy-looking and follows iritis or cyclitis.

The causes of the disease are not understood, but seem to be about the same as in episcleritis.

*Prognosis.*—Guarded, as the implication of the ciliary body and iris may lead to unfavorable results.

*Treatment.*—Locally atropine should be used throughout the attack, unless some contra-indication is present. The constitutional remedies given under episcleritis are used.

**SCLERITIS.**—A disease which usually implicates other tissues. The entire portion of the sclera may be affected. The color has a bluish cast with the red. Pain often severe. Increased lachrymation may be present.

*Causes.*—May result from rheumatism, gout, severe cold or scrofula. In the syphilitic form there are areas which are translucent, but of a yellowish-brown color. Gonorrhea has also been credited with causing this disease. In many cases it is impossible to assign any cause. Both eyes may be affected. The disease is chronic in character and may eventually affect the iris, vitreous, ciliary body, choroid and cornea. Malformation of the globe may result from this condition.

*Prognosis.*—On account of the marked tendency to recurrence not favorable. The main reliance must be placed upon constitutional measures, and these must be regulated by the condition of the general system.

**SCLERO-KERATO-IRITIS.** (Scrofulous Scleritis, Anterior Choroiditis). This condition involves, through extension, as the name indicates, the cornea and iris. The disease is essentially chronic and relapses are the rule. The disease starts in the scleral tissues of the ciliary region and invades the cornea, which becomes opaque and often presents an ulcerated surface. Inflammation of the iris follows and posterior synechiæ result. The pain generally is severe, and congestion is very marked in these cases, as a rule. After the subsidence of the disease, which may be weeks, discolored areas mark the scleral points of the disease, and haziness of the cornea indicates the seat of inflammation of this tissue.



The iritic changes are also marked, as in all inflammatory conditions of this membrane, viz., discoloration and often posterior synechiæ.

The subsequent attacks involve fresh scleral and corneal surfaces, as well as the iris; irido-choroiditic and vitreous changes may ensue, and at last the sclera may lose its regular form, being nodular and discolored. The cornea covered with opacities; the iris adherent to the anterior lens capsule, and the vitreous a fluid mass of floating opacities. An eye in this condition is practically useless.

*Treatment.*—It does not vary much from that already described under episcleritis, but the use of sulphate of atropine or hydrobromate of scopolamine should be persevered in, in order that a full mydriatic effect is maintained, on account of the iritic complication. Here as in all diseases of the eye, in which pain is present, there is a tendency to use cocaine; while it may relieve the pain temporarily, but its almost certain effect of injuring the corneal epithelium more than counterbalances any beneficial action. Constitutional treatment should be mainly relied upon, aconite in the earlier stages; cimicifuga, with the bruised feeling; bryonia, pain increased by motion; rhus, with pain relieved by motion, and the physiological effect of jaborandi should be obtained, as in these cases diaphoresis will usually give relief; colchicum, with a rheumatic, gouty condition. The salicylates are sometimes of benefit in the rheumatic type also. The iodides sometimes, combined with bichloride or biniodide of mercury in small doses, will be found beneficial where a syphilitic taint is present. The general health must be looked after and such measures as will improve the assimilative powers should be taken.

**SCLERAL STAPHYLOMA.**—Three forms are usually recognized, anterior, posterior and equatorial. The posterior is only recognized as a rule by means of the ophthalmoscope, the other two forms can be seen by ordinary inspection.

When through any cause there is increased intra-ocular

tension and diminished scleral resistance, bulging of the scleral walls may ensue, and staphyloma results. This process may commence in the sclera or underlying tissue. When the swelling is general, enlarging the eye in all diameters, the term buphthalmos is employed.

*Causes.*—Anterior choroiditis, chronic glaucoma, kerato-iritis with occlusion of pupil, cyclitis, tumors and wounds closed by elastic scar tissue.



FIG. 38.—Staphyloma of Sclera.—*Hansell and Bell.*

*Treatment.*—Attention to the causes of the disease. When there is increased tension an iridectomy may be required. If the eye is useless, an enucleation will generally give the patient relief from the pain and annoyance which usually accompany this condition.

**TUMORS.**—Scleral tumors are seldom seen, osteoma, sarcoma, fibroma, and enchondroma have been reported. Invasion of the sclera however, frequently occurs from growths in contiguous structures, although the resistance is such that infection comes late.

True scleral tumors are more likely to be sarcoma or carcinoma than epitheliomatous. The sclero-corneal margin is often a point of selection for these growths, while the ciliary body and conjunctiva also are not infrequently the tissues from which the invasion occurs.

*Treatment.*—If the growths are small and primarily scleral, they may be dissected from the sclera, and the conjunctiva



sutured. When they invade other structures and are malignant, early enucleation is the best method.

**SCLERAL ABSCESES AND ULCERS.**—These are rare, and when they do occur are usually the result of infected wounds, although occasionally seen in specific and contagious diseases. Through the breaking down of the tubercle, tumor, or gumma in adjacent tissues, the sclera may be affected.

*Treatment.*—When fluctuation is evident, an incision should be made, evacuating the morbid material. The administration of sulphide of calcium 1-100 gr. or silicea 1-100 gr. given in one grain doses every three hours in the early stages of the disease may prevent formation of pus; in specific diseases chloride of gold and sodium in 1-100 grain doses four times a day is often indicated.

**PIGMENTATION (Melanotic Spots).**—These are not pathological, and are seen more frequently in the brunette type and the colored race. They usually are situated close to the cornea. By some they are regarded as the starting point for malignant diseases.

**INJURIES AND FOREIGN BODIES.**—Wounds of the sclera may be caused by sharp bodies. (Forks, knives, scissors, glass, chips of iron, steel, etc.) or they may result from a blow causing rupture of the scleral coat; this is generally concentric with the corneal margin and about one-eighth in. away, although rupture may occur in the posterior portion of the globe. If the sclera has been perforated there is not only the danger from loss of vitreous, but also from infective material being carried into the globe, which may cause destructive inflammatory action.

If the penetrating substance is small, it will, unless considerable force is back of it, remain in the anterior of the eye, but if of any size the probability of its passing through the ball, and embedding itself in the orbital tissues must be borne in mind.

Foreign bodies may be embedded in any of the ocular

tissues, and if light, may be found in the vitreous, although the tendency is to settle to the lower portion of the globe. Copper and brass are almost sure to cause destruction of the globe, through purulent inflammation, evidently the result of chemical action on the metal. Small bodies frequently become encysted and cause no inconvenience either through discomfort or diminution of vision, but they are always a menace to the integrity of the eye.

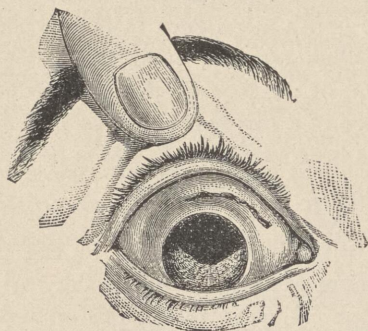


FIG. 40.—Rupture of the sclera with retrocession of the iris.—*Noyes*

The hemorrhages which usually follow these injuries, make it difficult or impossible to ascertain with the ophthalmoscope, whether a foreign body is present, and the use of a probe is usually harmful. If the offending substance is iron or steel, the use of a magnet will often determine its presence, and it may be removed by means of the electro-magnet. The application of the X rays may prove useful in these cases. Sometimes when a body has been located, it has been possible to remove it by means of delicate forceps, but such cases are exceptional. All instruments used in these manipulations, should be scrupulously clean. When the penetrating wound is sufficiently large there will be loss of vitreous, diminished tension, and if the vitreous loss is considerable, shrinking of the eyeball.

Hemorrhage into the vitreous and often into the aqueous chamber may be present. Dark tissue will present in the lips of the wound, consisting, according to location, of por-



tions of the iris, ciliary body or choroid, and even a bead of vitreous may also show.

If the wound is the result of a blow, rupturing the sclera, the danger to the deeper structures is generally considerable. Rupture of the choroid, detachment of the retina, dislocation of the lens, it may be backwards in the vitreous or forward into the anterior chamber, and sometimes even sub-conjunctival. Separation of a part of the iris from its attachment (irido-dialysis) is not infrequent from contusions.

*Prognosis.*—This depends upon the amount of tissue involved, situation of the wound, the amount of vitreous lost, and the presence of a foreign body, as well as whether septic material has been introduced. It is best always to give a doubtful prognosis in these cases.

*Treatment.*—Will vary according to the character of the injury, extent of the wound and as to the probability of a foreign body being present. The ciliary region has always been looked upon as most dangerous on account of inflammatory action here being more destructive to the eye than almost any other location. If a foreign body is present it should be removed if possible, and this manipulation should be carefully made. Absolute cleanliness should be observed. If the wound is small and there has been no loss of vitreous, or prolapse of tissue, the eye should be flushed with a saturated solution of boric acid, and a solution of sulphate of atropine, gr. iv to ʒj, should be used if there is much pain.

If the wound is large and there is any prolapsed tissue entangled therein, it should be removed with scissors and the conjunctiva stitched over the wound. The direction to suture the sclera, while in some cases it may prove beneficial, unless carefully done may do more harm than good. The utmost care regarding cleanliness must be observed, the eye should be closed and carefully bandaged. When there has been considerable loss of vitreous, vision destroyed, and on palpation the eyeball is distinctly soft, enucleation usually is the most conservative procedure. Occasionally, even after

slight penetrating wounds, and when healing has progressed seemingly favorably there will be detachment of the retina, shrinking of the eyeball, and so much irritation that enucleation will have to be performed, even when there is no sympathetic action in the other eye.

In favorable cases the employment of jaborandi will hasten absorption of the blood in the vitreous, as well as the opacities which frequently make their appearance after injuries. Iced cloths will often be found valuable in keeping down inflammatory action, and for the prevention of traumatic fever there is no drug as useful as *veratrum viride*. The bowels should be kept in an active condition, and in these cases the saline cathartics seem to act best.

Non-penetrating foreign bodies are sometimes found embedded in the scleral tissue, and as a general thing can be readily removed. Powder grains, bits of emery or steel may strike the ball with sufficient force to penetrate the conjunctiva and not do any serious mischief to the sclera. Their removal ordinarily is not difficult under cocaine anesthesia; the after treatment consists simply in washing the eye with a solution of boracic acid and keeping the eye fairly quiet for twenty-four hours.



## CHAPTER VII.

### DISEASES OF THE IRIS.

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#### ANATOMY.

This is the delicate membrane interposed between the cornea and lens. Near the center of this curtain is an aperture, the pupil, which is normally circular and nearly central. Through the peculiar structure of the iris the pupil in health responds to variations of light, expanding or contracting, the former in dim light, the latter in bright light, or in looking at near objects. The pupil having the effect of the diaphragm in a camera. At the periphery, the iris is attached to the inner surface of the eyeball, being continuous with the ciliary body. The outer coat is continuous with Descemet's membrane or posterior limiting membrane through the pectinate ligament. The pupillary border is free and rests on the anterior capsule of the lens, receiving firm support in its various motions.

The form given to the iris by these supports is slightly convex, unless the lens has been removed, when it hangs nearly vertically. The iris divides the aqueous chamber into two parts, the anterior chamber lying between the iris and cornea, posterior chamber between the iris and lens.

The structure of the iris is divided as follows :

#### A. IRIS, PROPER.

1. Anterior endothelium.
2. Anterior boundary layer.
3. Stroma.
4. Basilar layer.

## B. RETINAL IRIS.

5. Anterior layer of endothelium.
6. Posterior layer of endothelium.

Layers 2 and 4 are modifications of the stroma. The color of the iris is due partly to the pigment layer of the posterior surface showing through the stroma, and partly to pigmented cells in the stroma.

When the cells are few or lacking and the iris thin, the color is blue. If the iris is thicker and more opaque, gray, and when pigment cells are numerous in the stroma, the results are green, yellow, or brown, the deeper shades of brown giving what are usually termed black eyes. The color is distributed in two zones, the inner or pupillary being from 1-25 in. to 1-12 in. wide, darker in light eyes, and lighter in dark ones.

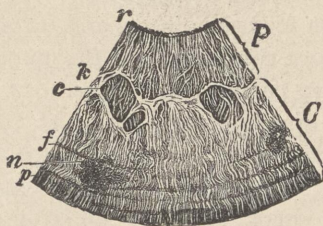


FIG.—41.—Anterior surface of the iris, magnified 6x1.—*Fuchs*.  
P, pupillary zone; C, ciliary zone; r, fringe of retinal pigment; k, lesser circle; c, crypt; f, contraction groove; n, naevus; p, peripheral dark zone.

The outer or ciliary zone is about 1-8 in. to 3-16 in., darker in dark eyes and lighter in light ones. The junction of the two zones is formed by zig-zag ridges. As a rule the two eyes of the individual are approximately the same, but occasionally they will be found of different colors.

Pathological changes of the iris are common, and in the majority of cases will leave permanent discolorations. This is to be remembered in examining the eyes. The iris which lacks the luster of its companion has in all probability suffered from inflammatory action.



The anatomical structure of the iris which causes contraction and dilatation of the pupil is one that has not been definitely settled, although by the majority of investigators, the presence of a dilator is conceded. The contraction of the pupil results from stimulation of the retina by light, especially excessive light, and also general stimulation by electricity or strychnine, deadening of the reflexes, sleep, coma, narcosis, first stages of chloroform or alcohol poisoning; the instillation of myotics, as eserine or pilocarpine and also when these drugs are taken into the circulation in quantities sufficient to produce their physiological effect. Opium and its derivatives also produce this effect. Diseases of the brain and meninges; local diseases of the eye, as iritis, etc., increase of blood pressure, as in forced expiration, or any condition causing congestion.

Accommodation for near objects and turning the eyes inwards also produce contraction of the pupil. Dilatation is caused by contrary conditions, deficiency of light, an insensitive condition of the retina, as found in amblyopia and amaurosis; mydriatics, as atropine, scopolamine, daturine, homatropine, etc.; depression of the nervous system, resulting from fright, shock, fatigue; the latter stages of chloroform or alcohol poisoning, lowering of the blood pressure, accommodation for distant objects, as well as numerous other conditions. Age also modifies the diameter of the pupil; in the new-born it is greatly contracted; in children, where the reflexes are active, it is large, in adults somewhat smaller, and in old age still more contracted.

In myopia it is usually large, while in hyperopia it is usually contracted. In old age the increase of connective tissue renders the iris less mobile, and reaction is much less active.

The nerves of the iris are derived from the ciliary plexus. They are first medullated, and quickly reunite within the ciliary zone, forming the iridian plexus, which becomes more dense as it nears the sphincter pupillæ. There are three

classes of fibers derived from this plexus : first, pale, non-medullated, evidently belonging to the sympathetic, passing backward towards the dilator, which are supposed to supply it ; second, medullated fibers, apparently sensitive, passing to the anterior surface ; third, medullated fibers passing to the sphincter and probably giving it its motor influence. The coats of the vessels are supplied by certain vaso-motor fibers. (See Fig. 42, colored plate.)

The tactile sensibility is slight, operations if traction is not made not being painful.

ARTERIES.—The arteries are derived from the long posterior ciliary and anterior ciliary arteries. The branches of these two sets of arteries finally form a vascular anastomosis about the ciliary border of the iris between the two portions of the ciliary muscle. This is called the greater arterial circle of the iris. From this, arterioles pass radially toward the pupil, lying in the stroma and dividing dichotomously with frequent cross-unions. At the periphery of the sphincter the branches form a fine circular mesh work, called the lesser arterial circle of the iris.

In fetal life, branches from this circle supply the pupillary membrane.

VEINS.—The veins of the iris arise from the pupillary network of the sphincter and the minute branches of the anterior surface, gathering into trunks that run backward, emptying finally into the vorticosae veins.

LYMPHATICS proper are not found in the iris, but lymphatic circulation is maintained by means of the numerous lacunar spaces occurring in the stroma.

#### ANOMALIES AND DISEASES OF THE IRIS.

ANOMALIES, CONGENITAL.—*Heterochromia*.—A condition in which the color of the two irides differs, or when one sector of the iris is of a different color than the rest. The difference is not a morbid one.



*Coretopia*.—An unusual position of the pupil. The anomaly may be slight or the position of the pupil may be close to the corneal margin. One or both eyes may be affected, and the condition has been observed in several members of the same family. This anomaly is sometimes mistaken for coloboma.

*Microcoria*.—Besides a small displaced pupil, there are cases in which the pupil may be small or normal in size, but undilatable even with mydriatics. This condition may result from posterior synechiæ, which develop during an attack of fetal iritis. Congenital cataract is not infrequently seen with this condition.

*Polycoria*.—More than one pupil. This condition is seldom seen. The pupils may be close together, divided by iris tissue, or the multiplicity may be the result of intersecting bands of persistent pupillary membrane. Rarely an opening is seen at the ciliary margin of the iris; this may be due to a congenital iridodialysis.

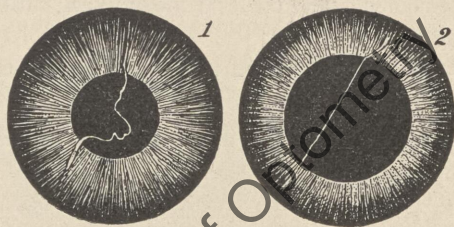


FIG. 43.—Persistent Pupillary Membrane.  
1, Pupil contracted. 2, Pupil dilated.

*Persistent Pupillary Membrane*.—This condition is the result of incomplete resolution of the membrane covering the anterior surface of the lens during fetal life; this membrane generally disappears during the seventh month, although it is sometimes present at birth. It consists of gray or brown tissue, lying upon the anterior capsule of the lens, in the pupillary region, and is usually connected with the iris by brown filaments. These are sometimes mistaken for poste-

rior synechiæ, but do not come from the margin of the pupil, but from the anterior surface of the iris; they do not interfere with the mobility of the pupil, and when the pupil is contracted the filament usually can be seen to have assumed a sinuous position. In dilatation it is generally tense. No treatment, operative or otherwise, is required for this condition.

*Irideremia* (aniridia).—Partial or total absence of the iris. The eye with this condition presents much the same appearance as in extreme mydriasis.

Complete irideremia is generally bilateral and often is associated with other anomalies; frequently anterior polar cataract, partial or complete cataract, dislocation of the lens, nystagmus, strabismus, etc. In the partial forms there may be nodules or crescentic pieces of the iris present, with frequent filaments of pieces of pupillary membrane. Ophthalmoscopic examination will reveal the border of the lens and even a fine striated appearance beyond the lens margin, which is due to fibers of the suspensory ligament.

Vision is deficient and the patient partially closes the lids to diminish the amount of light entering the eye. Heredity is evidently an important factor in this condition.

*Congenital Ectropion of the Uvea*.—This consists of a roundish mass, dark colored, situated at the margin of the pupil, projecting forward to the anterior border of the iris.

This condition seems to be normally present in horses' eyes, and is sometimes seen in the eyes of cows.

Other congenital defects may be cysts, nevi and atrophy of the iris.

*Coloboma of the Iris*.—A condition in which there is lack of tissue in some portion of the iris, giving the appearance of an artificial pupil, and is usually in the lower half, extending downward with an inclination to one side or the other. The deficiency may be considerable regarding width, and also may extend to the periphery of the iris or only part way. Generally there is associated with this condition colo-



boma of the choroid, ciliary body, or of the eyelid. Hare lip and cleft palate are not infrequent.

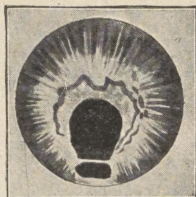


FIG. 44.—Congenital Coloboma (with bridge).—Fick.

*Discoria*.—An abnormal shape of the pupil without deficiency of iris tissue. Persistency of portions of pupillary membrane or posterior synechiæ from fetal iritis may be causes of this condition.

*Anterior Synechiæ of Iris and Persistent Pupillary Membrane*.—Seldom seen. Probably due to defective development of the eye, some of the tissues forming the interior structure being interfered with in some manner. The idea is also held that there has occurred corneal perforation *in utero*.

*Iridodonesis* (Tremulous Iris).—This condition is sometimes found in connection with ectopia of the lens or in buphthalmos. Here the normal support of the posterior surface of the iris is lacking and an oscillating motion of the iris is noticeable on motion of the eye.

FUNCTIONAL, MOTOR DISTURBANCES OF THE IRIS.—Mydriasis or dilatation of the pupil. Myosis or contraction of the pupil. Hippus an alternate dilatation and contraction of the pupil irrespective of accommodative action or light influence. Any of these conditions may result from functional disturbances.

IRITIC INFLAMMATIONS.—The iris and ciliary body constitute the anterior division of the middle tunic of the eye, that is of the uveal tract.

Anatomically they are continuous and receive their blood

supply from the same vessels. Histologically there are many points of resemblance.

Inflammation of the ciliary body as a rule will eventually implicate the iris, irido-cyclitis resulting. It rarely occurs that iritis does not follow cyclitis.

Primary iritis however does not necessarily lead to cyclitic complications, although it is not infrequent.

The differentiation of the two diseases is often difficult. The choroid on account of the close anatomical relations is often affected in diseases of the iris and ciliary body.

**HYPEREMIA OF THE IRIS.**—The distinction between hyperemia and the early stages of inflammation, is sometimes difficult. In the true hyperemic condition the symptoms quickly subside, but it is always best to be on the safe side and treat it as a beginning inflammation.

*Causes.*—Blows on the eye, foreign bodies, corneal ulcers, acute trachoma, purulent conjunctivitis, scleritis—any of these conditions may produce hyperemia.

*Symptoms.*—Contracted pupil, which reacts slowly to light and mydriatics, slight discolorations of the iris, giving a greenish cast to a blue, or reddish brown to a brown iris. This may affect part or all of the iris tissue. There is also a slight pericorneal zone of redness. There may be increased lachrymation, and photophobia is nearly always present.

*Treatment.*—As this condition is more of a symptom than a disease, the removal of the exciting cause will be in the majority of cases all that is required. Locally the use of the boric acid wash, with rest of the eye, will be sufficient. If any doubts are entertained regarding it being an early inflammatory stage, rest and the employment of a mydriatic are advisable, either sulphate of atropine or hydrobromate of scopolamine. The latter is preferable, as in case there is no true inflammation, the effect of the drug passes off quicker, and there is less danger of conjunctivitis from the instillation than there is from the use of a solution of atropine.



IRITIS.—Inflammation of the iris may be classified as (1) idiopathic; (2) symptomatic, the result of diseases of other portions of the eye, or systemic affections; (3) traumatic. Another division may be made of active and passive or "*quiet iritis*". In the latter condition the disease is especially insidious, and as the prominent symptoms of iritis are lacking, it is frequently overlooked.

The general characteristics of iritis are: (1) Change in the color of the iris, loss of luster with a muddy appearance. There is always exudation of plastic, serous, or purulent material in these cases. This exudate may be in the substance of the iris; the anterior or posterior surface; into the pupillary space or into the aqueous humor. When the exudation is in the iris tissue, there is more or less thickening of the membrane which may involve the entire structure, causing it to look thick, muddy and dull.

Exudation on the anterior surface in the early stages dulls the luster, as though it had been breathed upon, there being some alteration of the epithelial covering, giving a roughened appearance. Change of color follows. Nodules varying from round to oval, and of a rusty color, are generally present in iritis resulting from secondary syphilis. These are such constant attendants that they are considered pathognomonic of this condition. The nodules are small as a rule, seldom exceeding one-twelfth of an inch in diameter, and seem to prefer the pupillary margin, although sometimes seen on other portions of the iris.

Posterior exudation has taken place when adhesions (synechiæ) have occurred between the iris and the anterior capsule of the lens. This results from the exudation of plastic material at one or more points from the iris. The point of selection usually is where the iris and lens capsule are in closest contact, and this is about the pupillary margin. These attachments vary in width and length and may be single or multiple. When the entire pupillary margin is adherent, eliminating all communication between the an-

SURFACE OF CHOROID AND IRIS EXPOSED BY REMOVAL OF SCLEROTIC AND CORNEA, SHOWING DISTRIBUTION OF BLOOD-VESSELS AND NERVES.

(Twice natural size. After Zinn.)

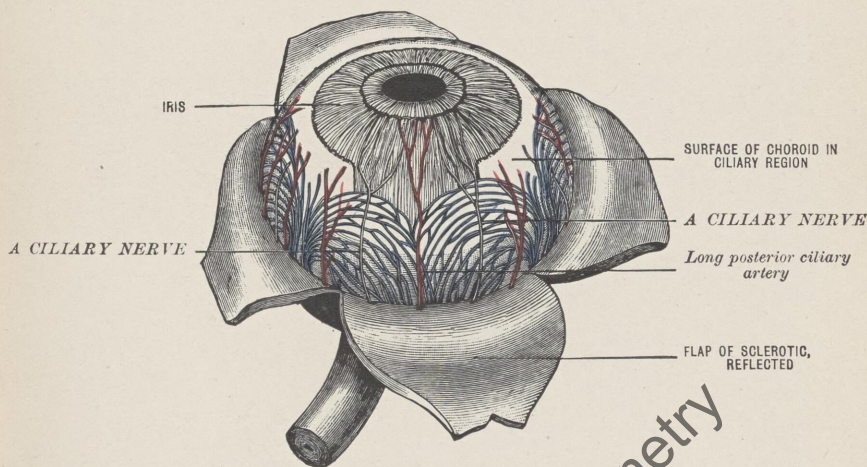


FIG. 42.

(Morris)

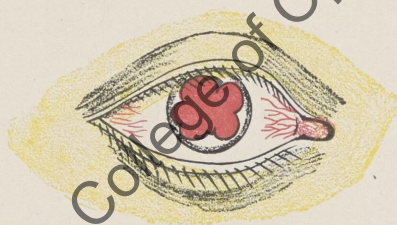


FIG. 45.

Posterior Synechia. A mydriatic has been used. Ophthalmoscopic view.

(Fick)



terior and posterior chambers, it is called *exclusion*. A condition sometimes found, but more common in cyclitis, is where the posterior surface of the iris, as a whole, is adherent to the capsule of the lens, *total posterior synechiæ*.

Synechiæ, if recent, can sometimes be broken down by the use of mydriatics, rarely this occurs without these drugs, when there may be seen small dots on the lens capsule, which probably are never absorbed and remain as evidence of a previous iritis. If numerous, the dots will be arranged in a more or less circular form, and will be inside of the margin or the normal pupil, as during inflammation of the iris the pupil is nearly always contracted. These dots cannot usually be seen without the aid of oblique illumination or the use of the ophthalmoscope.

Exudation of lymph upon the anterior lens capsule and into the pupillary space is not uncommon. The appearance usually is that of a grayish-white fringe, attached to the free edge of the iris. This grayish exudation may cover the entire pupillary area, and may have one or more openings. It sometimes however is continuous with the iris, producing what is termed *occlusion*. Occlusion diminishes vision in proportion to the density of the exudate, while exclusion eventually leads to increased tension.

There is always more or less exudation into the aqueous in iritis, but the amount may be so small that the change will hardly be apparent. There may be simply a slight cloudiness, or the amount may be so abundant as to obscure the iris and pupil. In this condition if the lymph settles to the bottom of the anterior chamber, what is known as hypopyon exists. Occasionally rupture of some of the blood vessels of the iris occurs, and there will be effusion of blood into the aqueous, producing what is termed *hyphemia*.

2 *Pain*.—The amount of pain varies, from its absence in "quiet iritis" to the intense pain of the active or "neuralgic" form. Different terms are applied to describe the pain, as dull, sharp, cutting, stabbing, throbbing, etc. This con-

dition is usually paroxysmal and seems to reach the acme of severity during the night. The pain may be confined to the eyeball, which then is usually sensitive to touch; movement of the ball increases the suffering. As a rule the pain seems by preference to follow the supra-orbital or infra-orbital branches of the fifth nerve, being most active in the frontal, temporal or superior maxillary regions. In some cases there will be severe pain in the ear on the same side, so unless a careful examination is made, an acute otitis media may be diagnosed.

Tension is frequently increased slightly, and in the aged this may be the starting point of glaucoma.

3. Lachrymation and photophobia are present, as a rule, and usually increase or diminish in proportion to the severity of the paroxysms of pain, although they may be marked symptoms when pain is comparatively absent.

Photophobia is not so marked in iritis as in keratitis, but if it is considerable there is almost sure to be spasm of the orbicularis muscle.

4. Systemic symptoms are nearly always present. Fever, excepting in severe attacks however, is not very noticeable. The skin may be dry; the tongue usually coated; specific gravity of the urine high, and constipation is nearly always present.

5. *Pericorneal Injection.*—In nearly every case of iritis there is a zone of redness surrounding the cornea. As a rule, it is one of the first symptoms seen, and is one of the last to disappear. This zone will vary from a light pink to a deep red, depending upon the severity of the attack; the more severe the inflammation the deeper the color.

In very severe cases there is more or less implication of the conjunctival vessels, and the zone cannot be readily distinguished. Chemosis usually is present in these cases and also slight swelling of the upper lid. The width of the circumcorneal zone varies, the milder the attack the narrower,



the more severe the wider, and in the latter case it may be  $\frac{1}{4}$  in. in breadth.

This zone is not proof positive of iritis, unless other evidences of the disease are present. Keratitis or cyclitis may show a zone, but in cyclitis the color is usually more violet than red.

6. *Myosis*.—Contraction and partial or complete immobility of the pupil is one of the earliest positive signs of iritis. This condition is probably due, in a great measure, to irritation of the ciliary nerves, causing contraction of the sphincter muscle. Engorgement of the vessels of the iris is also undoubtedly a prominent factor.

It is often difficult to obtain dilatation of the pupil with mydriatics, even when adhesions are not present.

7. *Haziness of the Cornea*.—This may result from infiltration into the corneal tissues, or by deposits on Descemet's membrane.

8. *Disturbance of Vision*.—This will vary according to the amount of cloudiness of the media. If the deficiency of vision is great, it is a general indication of extension of the disease to the ciliary body or deeper structures, unless there has been sufficient exudation to more or less occlude the pupillary space. The condition of the cornea must of course be taken into consideration before making a diagnosis of implication of the deeper structures.

*Diagnosis*.—The symptoms already described should make a diagnosis easy, but many errors are made, especially of conjunctivitis. In the aged, glaucomatous conditions will frequently have to be differentiated from iritis.

#### DIFFERENTIAL DIAGNOSIS.

##### IRITIS.

1. Severe pain in superciliary region, worse at night and in damp weather.
2. Vision impaired.

##### SIMPLE CONJUNCTIVITIS.

1. Sensation of foreign body on the eye, or under the upper lid.
2. Vision unimpaired, unless there is abundant secretion.

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3. Peri-corneal injection, more or less marked. Blood vessels not movable with the conjunctiva.

4. Lachrymation variable, seldom abnormal secretion.

5. Contracted, sluggish or immovable pupil.

6. Iris discolored.

7. Reaction to mydriatics slow.

8. Marked photophobia rarely seen.

9. Conjunctiva generally clear, sometimes chemotic.

10. Tenderness on pressure slight.

11. Posterior synechiæ and possibly exudation into the pupillary space.

12. Unless traumatic, usually between the ages of twenty and forty-five.

13. Tension often slightly increased.

#### PHLYCTENULAR CONJUNCTIVITIS.

1. Irritation generally acute.

2. Vision impaired when cornea is involved.

3. Conjunctival injection diffuse, vessels running in direct lines to phlyctenules, and movable with conjunctiva.

4. Lachrymation profuse.

5. Pupil usually mobile.

6. Iris normal.

3. Conjunctival injection, vessels movable with the conjunctiva.

4. Lachrymation increased, mucopurulent secretion; flakes of lymph.

5. Pupil normal.

6. Iris normal.

7. Reaction to mydriatics normal.

8. Severe photophobia absent.

9. Conjunctiva opaque, velvety, and occasionally chemotic.

10. Tenderness slight if any.

11. No synechiæ.

12. May occur at any age.

13. Tension normal.

#### ACUTE GLAUCOMA

1. Pain in eye and head, which may extend to occipital region, constant. Often without premonitory symptoms.

2. Vision impaired, field contracted, has been changing rapidly from bad to worse.

3. Peri-corneal injection more or less marked. Vessels not movable with cornea in early stages usually.

4. Lachrymation variable.

5. Dilated, often oval, sluggish pupil.

6. Iris may be discolored.



- |                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p>7. Reaction to mydriatics normal.</p> <p>8. Photophobia severe, blepharospasm.</p> <p>9. Conjunctiva translucent, swimming in tears.</p> <p>10. Tenderness slight if any.</p><br><p>11. No Synechiæ.</p> <p>12. Disease of childhood usually.</p> <p>13. Tension normal.</p> | <p>7. If in doubt never try a mydriatic.</p> <p>8. Photophobia may or may not be marked.</p> <p>9. Conjunctiva more or less inflamed, sometimes chemotic.</p> <p>10. Tenderness on pressure usually not marked, and diminished sensibility of cornea.</p> <p>11. No synechiæ, or exudation in pupil.</p> <p>12. Seldom seen under thirty-five years.</p> <p>13. Tension markedly increased.</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The types of iritis vary so much that it is impossible to give any set rules, but careful attention to the foregoing symptoms should eliminate errors of diagnosis.

A diffuse scleritis may simulate closely, so far as a pericorneal zone is concerned, an iritis, and it may be a complication.

*Course, Complications and Prognosis.*—Iritis may be acute, sub-acute or chronic. The acute form speedily reaches its full virulency, then diminishes, so that in four to eight weeks the disease has subsided. A few cases have been known to run their course in a few days, but these are rare. Occasionally there will be no evidence of the disease, but this seldom occurs, excepting in very mild cases, and in all probability they are examples of mistaken diagnosis. The rule is for synechiæ or pigment spots on the anterior capsule of the lens, as well as some discoloration of the iris, to show that there has been an iritis attack.

There are persons who have recurring attacks of this trouble on every slight exposure.

Sub-acute iritis as implied by the name, does not have as marked symptoms as the acute, but the disease is much more persistent, lasting longer and yielding to treatment much more slowly. The morbid changes are more marked, and synechiæ are probably always present.

Chronic iritis is not often seen, but may be of this character from the onset, or may result from acute or sub-acute forms. The symptoms are not marked as a rule, but there is more or less irritability of the eye, pupil sluggish and slightly contracted, and exudative changes in the iris are usually present.

In quiet iritis (insidious iritis) the inflammatory signs are very slight or absent. Diminution of sight being first noticed by the patient. Adhesions may be present, and an excluded or occluded pupil discovered on careful examination. This condition has been ascribed to various causes, such as congenital syphilis, rheumatic or gouty diatheses, or sympathetic inflammation, but the most probable is a marked general debility, for when this condition is present there is a tendency to the asthenic types of diseases.

In some individuals there is a tendency to hemorrhage into the anterior chamber during an iritic attack. This is sometimes called hemorrhagic iritis, but probably should be looked at as a complication instead of a distinct type. The hemorrhage may be profuse or slight. When the entire pupillary edge of the iris is adherent to the lens capsule (exclusion of the pupil), the space between the iris and the lens becomes filled with fluid, pushing the iris forward, obliterating the angle of the anterior chamber, and

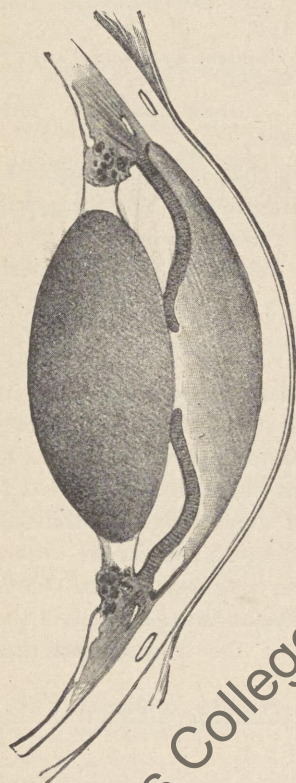


FIG. 45.-Iris bombe shown in section, slightly diagrammatic. Berry.

ward, obliterating the angle of the anterior chamber, and



giving the lens the appearance of being at the bottom of a crater. This is called *iris bombe*. Other tissues may be involved besides the iris during inflammatory action: The cornea (keratitis punctata), ciliary body (irido-cyclitis), choroid (irido-choroiditis), vitreous (hyalitis), and the optic nerve and retina (hyperemia or neuro-retinitis).

The liability of some of these complications, as well as the tendency of some types to recurrence, must be borne in mind in giving a prognosis. In complicated cases, if seen early, and proper treatment is persisted in, the results should be favorable.

Iritis is further divided into plastic, parenchymatous and serous, depending on the pathological condition. The subdivisions usually given are according to the etiology, syphilitic, rheumatic, etc.

PLASTIC IRITIS.—The simple form of this disease is the most common, and may be acute, sub-acute or chronic in character. The general line of symptoms prevail: Pericorneal injection, contracted, immobile pupil, iris discolored, and posterior synechiæ. The exudation may be so extensive as to occlude the pupil, and rarely there will be a gelatine-like mass in the anterior chamber. The term *fibrinous or spongy iritis* is sometimes given for this condition.

Plastic iritis is common in syphilis (syphilitic plastic iritis). This form is seen during the earlier stages of syphilis, and is usually devoid of characteristic symptoms of specific disease; so a careful inquiry into the history will, in many cases, be necessary to make a positive diagnosis.

The percentage of cases of iritis due to syphilis is given as from 30 to 60 per cent. The usual time for this form of iritis to develop is between the second and ninth month after the initial lesion; it may appear however as late as the eighteenth month. Generally both eyes are affected; the disease may affect both simultaneously, but, as a rule, one eye is affected a little later. The disease is, as a rule, acute, and after a complete cure does not show a tendency to relapse.

In a few instances sub-acute or chronic forms have been seen.

Acute plastic iritis is common in new-born infants of syphilitic parents. In children with inherited syphilis the disease has been seen between the ages of two months and fifteen months. Children having acute iritis will, as a general thing, be found to be the victims of hereditary syphilis.

A serous form of iritis in hereditary syphilis may manifest itself during the later years of childhood. In severe plastic cases the vitreous and ciliary body are very likely to be affected.

SCROFULOUS IRITIS.—This condition is found in scrofulous and anemic children. The disease so closely resembles that produced by hereditary syphilis that some writers claim that it is really an attenuated syphilitic condition. The disease runs a similar course to that already described.

RHEUMATIC IRITIS.—The rheumatic type of plastic iritis is quite common, some claiming this to be the most prevalent form. It is seen most frequently between the ages of twenty and fifty. Other symptoms of rheumatism may be present or absent. The symptoms in this type are usually more severe than in the syphilitic, and the tenderness of the globe is marked, a bruised sensation usually predominating. As a rule, but one eye is affected at a time, the fellow eye following after a variable period. This form of iritis is prone to relapses, although a considerable interval of time may elapse between the attacks. This tendency is often termed *recurrent iritis*, and is also of diagnostic importance in distinguishing it from syphilitic iritis.

#### DIFFERENTIAL DIAGNOSIS.

##### RHEUMATIC.

1. History of articular rheumatism or other rheumatic symptoms.
2. Marked pain, photophobia and increased lachrymation.

##### SYPHILITIC.

1. History of acquired syphilis.
2. Pain, photophobia and lachrymation not equally marked.



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| <p>3. Nodes of iris never present.</p> <p>4. Slight exudative changes.</p> <p>5. Synechiæ generally long, thin and non-pigmented.</p> <p>6. Iris often unusually bright.</p> <p>7. "Cross hatching" and punctate keratitis seldom seen.</p> <p>8. Slight tendency to formation of pigment upon the anterior capsule of the lens.</p> <p>9. Choroido-retinitis not present.</p> <p>10. Vision eventually good.</p> <p>11. Often recurrent.</p> | <p>3. Nodes probably always present.</p> <p>4. Exudative changes extensive.</p> <p>5. Synechiæ usually short and pigmented.</p> <p>6. Iris generally dull and muddy.</p> <p>7. "Cross hatching" and punctate keratitis frequently seen.</p> <p>8. Pigmentation upon the anterior capsule of the lens frequently present.</p> <p>9. Choroido-retinitis present frequently as shown by diseased spots in the choroid, blurring of the optic disk, etc.</p> <p>10. Vision usually impaired, both during and after the attack.</p> <p>11. Seldom recurrent.</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Quiet iritis as already described may result from rheumatic or syphilitic taint. The symptoms of this type have already been given.

GOUTY IRITIS.—This form resembles rheumatic iritis, in its tendency to affect one eye at a time, and also in being recurrent. The general line of symptoms are similar to those already given. The children of gouty parents sometimes have an insidious and destructive form of iritis nearly always associated with disease of the vitreous. These children "have a peculiar squareness of build, heavy features, florid complexion and feebleness of circulation in the extremities." (Hutchinson).

GONORRHEAL IRITIS.—Fortunately this is a rare type of iritis, but when it does occur it is nearly always plastic. It may or may not be an accompaniment of other constitutional gonorrheal symptoms. The pain is usually very severe, but the other symptoms do not vary from the other forms of plastic iritis. Recurrence may follow each infection of the patient.

.DIABETIC IRITIS.—Plastic iritis may appear in diabetic subjects without any apparent cause and may also develop after an operation on the iris. The disease is most intractable to treatment, and hemorrhage into the anterior chamber occasionally occurs. In stubborn cases of iritis, analysis of the urine should be made.

PARENCHYMATOUS IRITIS.—The characteristics of this form are general or localized discoloration or swelling of the iris, the result of inflammation and cellular proliferation within the iris tissue. When the swelling is general, through exudation the pupillary margin may be adherent to the anterior lens capsule. If localized, one or more yellowish nodes, perceptibly raised above the level of the iris, may be seen, and vessels may be distinguished crossing them. The effusion into the stroma of the iris may become purulent, filling the pupillary space and hypopyon result.

Parenchymatous iritis is divided into:

SYPHILITIC PARENCHYMATOUS IRITIS (Iritis Papulosa, Gummatous Iritis).—In the latter stages of secondary syphilis, iritis may develop which possesses distinctive features of its cause. These may show during an attack of plastic iritis, or independently of such an attack. There will be one or more yellowish or reddish-yellow nodes, situated in the iris tissue, most likely close to the pupillary or ciliary borders, although occasionally between them; these nodes vary from the size of a hemp-seed to a small pea, if small they seem to be more often multiple, but seldom exceed four in number. Fine vessels cross the nodes. The iris tissue between the nodes is usually comparatively free from infection. These nodes resemble gummata, but belong to a comparatively earlier stage of syphilis. Absorption gradually takes place, leaving no distinct scars, or atrophy to mark their location.

GUMMA OF THE IRIS.—This condition is seen in the so-called tertiary stage of syphilis. The nodule is single, the point most generally affected being the ciliary border. The



size of the swelling is usually considerable and the tendency is to grow toward the ciliary body. Through fatty degeneration the nodule disappears, atrophy or scars of the iris remaining.

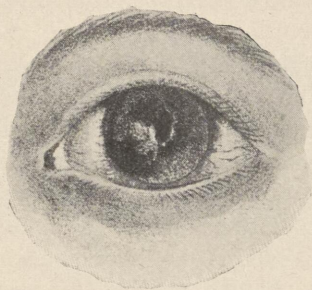


FIG. 46.—Gumma of the Iris.

**INFECTIOUS DISEASE IRITIS.**—This division covers many causes that can hardly be called infectious, but will be grouped under this heading.

Iritis is occasionally seen during or following : pneumonia, cerebro-spinal meningitis, typhus and typhoid fever, influenza, recurrent fever. Purulent iritis, the result of embolism, may occur in septicemia, following puerperal fever and pyemia. "Malaria," so called, has given rise to *periodical iritis*. *Iritis catamenalis* is very rarely seen, the exacerbation occurring before each menstrual period.

**IDIOPATHIC IRITIS.**—When neither injuries nor systemic conditions can be ascribed as causative factors, an iritic attack is termed idiopathic. Seldom seen in elderly persons. Occasionally in adults, usually men, and a slight plastic form in children, more frequently girls nearing puberty. A cold is sometimes given credit for producing the disease. Generally but one eye is affected.

**TRAUMATIC IRITIS.**—As the name indicates, this form of iritis is the result of an injury, either operative or accidental. In dissection of the lens, the swollen cortical material coming in contact with the iris tissue may incite an iritis.

**SYMPATHETIC IRITIS.**—See irido-cyclitis.

**SECONDARY IRITIS.**—This term is used to indicate those cases in which the attack is the result of extension of inflammatory action from other tissues of the eye. Severe keratitis, perforating ulcers and sloughing ulcers of the cornea are frequently exciting causes. Scleritis may be a complication, or be complicated by sympathetic iritis. In rare instances the primary disease is located in the deeper structures of the eye; detachment of the retina, intra-ocular tumors, and vitreous exudates have been given as exciting factors.

**SEROUS IRITIS** (Descemetitis, Aquo-Capsulitis, Keratitis Punctata, Serous Cyclitis).—This condition has been a "bone of contention" as regards the classification of the disease. The consensus of opinion now seems to be in favor of the disease being a cyclitis, the deposit on the posterior surface of the cornea being given off from the ciliary body. Descemet's membrane does not seem to be implicated in the majority of cases at least. The disease is often seen associated with other affections of the eye. It is quite common in sympathetic ophthalmitis. It frequently appears as a late manifestation of syphilis, occurring at times as late as thirteen years after the initial lesion. Anemic patients, as well as rheumatic and gouty individuals are sometimes subjects of this type of iritis.

*Symptoms.*—Inflammatory symptoms are slight or absent in the majority of cases. The color of the iris is often unchanged and the pupil usually somewhat dilated; seldom, if ever, being contracted. The anterior chamber is often deepened and there is frequently a haziness of the cornea and aqueous humor. In nearly all cases the characteristic symptom of this disease is the deposit of opaque, brownish or reddish-brown exudate on the posterior surface of the cornea. The appearance is that of dots or fine grains of sand, and the arrangement of particles is almost invariably triangular, the apex pointing toward the center of the cor-



nea, the base being at the lower margin. The exudate consists of serous or sero-plastic material containing pigment granules. In the mild types of the disease, where the deposit consists mostly of fibrin with but few round cells, absorption gradually takes place, leaving the surface clear.

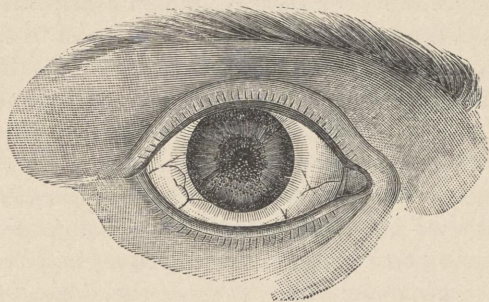


FIG. 48.—Serous Iritis.—Noyes.

In severe cases with the exudate rich in round cells, the tendency is towards organization. The iris becomes atrophic, and covered with a fine membrane of connective tissue. This rule also holds when the exudation covers the pupillary space, or is in the anterior chamber, and also into the vitreous chamber.

Tension of the globe is often increased during the early stages, but later may be less than normal. If the exudation is considerable in the posterior chamber, posterior synechiæ form, and when they are extensive, secondary glaucoma results.

Severe keratitis, perforating ulcers and sloughing ulcers of the cornea are exciting causes. Scleritis may be complicated with this disease. Very rarely the primary disease is located in the deeper structures of the eye. Detachment of the retina, intra-ocular tumors, or vitreous exudates may be exciting causes.

**CHRONIC IRITIS.**—Any of the types of iritis may become chronic. In this condition, unless a plastic irido-choroid-

itis results, there will be the same general line of symptoms. modified of course by the chronic character of the disease.

*Treatment.*—This naturally divides itself into operative and medicinal. In ordinary cases operative measures are uncalled for. In serous iritis, with continuous increased tension paracentesis is indicated. When hypopyon is a complication, as it may be in secondary iritis, and in irido-cyclitis, or if an accumulation of exudate partly fills the anterior chamber in gummatous iritis, the evacuation of the material may be required, Saemisch's operation being given the preference. (See operations).

In recurrent forms, or where a complete cure seems impossible, as shown by persistent pericorneal injection and an irritable condition of the eye, an iridectomy may be required. It is best to be conservative in these cases however, as the results are not always satisfactory.

In chronic iritis, where there is exclusion of the pupil and bulging of the iris, an iridectomy is indicated. If the increase of tension is marked, threatening glaucoma, the same operation is always advisable.

Contra-indications for iridectomy usually are punctate keratitis, chronic thickening of the iris with extensive attachments, high degrees of myopia, with tendency to spontaneous hemorrhage, hypopyon, or a subnormal tension.

An iridectomy should only be made for a definite purpose. (1) As a preventative for recurrent attacks. (2) To re-establish communication between the anterior and posterior chambers, which would tend to improve the nutrition of the eye, and also prevent glaucoma. (3) The formation of an artificial pupil, which may improve vision when the normal one has become practically useless.

The point selected for the operation is generally decided by the condition of the iris, the nearest normal being the best ordinarily. The tension, field of vision, and condition of the deeper structures should be determined if possible, for if examination shows marked abnormal changes, an operation



is contra-indicated. The opinion prevails among many that posterior synechiæ remaining after subsidence of an iritis are factors in causing recurrent attacks. This however is a mooted question. Various operations have been advocated for dividing these adhesions, the term *corelysis* being used to designate the character of the operation.

*Medicinal Treatment.*—This may be divided into local and constitutional. Only general rules for local treatment can be given, as there are frequently contra-indications, which will have to be taken into consideration.

*Mydriatics.*—Unless there is a positive contra-indication, and this seldom occurs excepting in serous or sympathetic iritis, mydriatics should be used first, last and all the time. They should be used as long as the eye reddens perceptibly on slight manipulation of the lids against the eyeball. In serous and sympathetic iritis, mydriatics are frequently contra-indicated. Sulphate of atropine is the mydriatic usually employed, and if a solution is made with the addition of boric acid, gr. vj to fl.ʒj, the danger of atropine conjunctivitis is reduced to the minimum; however, in cases showing an intolerance to atropine, hydrobromate of scopolamine may prove a valuable substitute. Other mydriatics are sometimes employed, but the preference is given to the atropine or scopolamine.

The application of cold or heat will frequently give a great deal of relief to the patient. Cold applications are usually indicated in traumatic cases. The application should be made in a similar manner as in ophthalmia neonatorum; this method will be found to be the easiest applied and least annoying to the patient. The application of heat or cold cannot however arbitrarily be determined. In those cases in which the cornea is affected, heat is in nearly every case the best.

Heat can be employed either by means of cloths wrung out of hot water, or by using small bags of hops, bran or any light substance which can be heated in an oven to the

required temperature, and laid over the eye, changing frequently enough to keep up the heat. The utmost care must be observed in using moist applications, else a poultice effect will probably produce complications that will be difficult to combat. The relief or aggravation of the symptoms, as a rule, are better known by the patient than by the attending physician, and one can usually be safely guided by their sensations. In some cases the alternation of cold and heat will afford the most relief.

*Constitutional Treatment.*—In acute iritic attacks the use of aconite in doses of gtt. 1-5 to 1-3 every two hours will be found beneficial. If however the iritis is due to a traumatism veratum viride in doses of gtt. 1-6 to ss every two hours will be better. Jaborandi, where plastic exudation has occurred, this should be given in doses of gtt. j to iij combined with the aconite. In cases where movement of the eyeball affords relief, rhus tox. in doses of gtt. 1-10 every two or three hours. When freedom from motion affords most relief, seeming to ease the pain, bryonia in doses of gtt.  $\frac{1}{4}$  to ss every three or four hours. If the eyeball and surrounding tissues have a bruised feeling, cimicifuga in doses of gtt. ss to j every two or four hours. If the patient is restless with an irritable condition of the nervous system, and the sensation that the body does not fit the bed, gelsemium in doses of gtt. ss to j every one or two hours. If a syphilitic history is obtained, the iodides, preferably iodide of potassium, should be given until the characteristic metallic taste in the mouth is obtained, and also the thin, watery discharge from the nose; when these conditions present the dose of the drug should be lessened, keeping just within the physiological limit.

In some cases belladonna will be found beneficial; these cases present a peculiar appearance of the face, as though the patient had been exposed to cold. When atropine is used as the mydriatic, it is not often that this drug will be required. If there is a stinging pain, lids and conjunctiva



somewhat edematous, apis in doses of gtt. 1-10 to 1-5. If the swelling of the lids is considerable, affecting both upper and lower lids, and with chemosis of the conjunctiva, apocynum in doses of gtt. ss to j every two or three hours, without however carrying the effect of the drug to the point of irritation of the alimentary canal. Corrosive chloride of mercury or red iodide of mercury, in the early stages of secondary syphilis, giving the drug selected in 1-100 gr. doses every three hours until there is slight tenderness of the gums.

In rheumatic cases the use of rhus tox., bryonia and cimicifuga, should be given according to the indications already described. Iodide of potassium is also frequently indicated in rheumatic types, even where no syphilitic taint is present. A pale, leaden hue of the tongue and mucous membrane of the mouth being an indication for its use. If an irritable condition of the alimentary canal exists, it is contra-indicated. Salicylic acid or some of the salicylates will often give prompt relief in the rheumatic type. Rhamnus californica has benefited some cases, probably through its cathartic action, as it is an axiom in iritis to keep the bowels in active condition. In gonorrheal cases the administration of gelsemium will be found beneficial in those patients having an irritable condition of the bladder; in those cases there will also, as a rule, be general irritable manifestations, restlessness, and an inability to sleep, irrespective of the pain, the dose should be from gtt.  $\frac{1}{3}$  to j every hour until this condition is relieved.

In gouty cases, as well as rheumatic, where there is swelling of the joints, colchicum in doses of gtt. j to iij every two or three hours is often a valuable remedy. The full physiological action of the drug however should not be obtained on account of the irritation it is liable to produce.

In diabetic cases the treatment must be directed to improve the general condition if possible.

In those so-called malarial types, the use of quinine is indicated where there is not an irritable condition of the nerv-

ous or alimentary systems. With the tongue moist and clearing, skin moist and soft, quinine will act kindly. If the contrary conditions are present, the drug will almost invariably prove detrimental. Liquor potassii arsenitis, in doses of gtt. ss to j, will be found most valuable in those cases having a dry inelastic skin, tongue pale and expressionless, tissues flabby, and a general debility of both the cerebral and sympathetic system. Here the liquor potassii arsenitis will be found much more valuable than quinine.

In scrofulous and tuberculous types especial attention to the general health must be given. In these cases the use of arsenic, in the form of liquor potassii arsenitis, or iodide of arsenic is indicated. If the former is used it may be combined with syrup of calcium lactophosphate, gtt. j of the arsenical preparation in each fluid 3 of syrup. A moderate amount of exercise may be beneficial in these cases, but care must be taken not to produce fatigue.

The eliminative functions must be kept active without being carried to the point of exhaustion.

Calcium, in some shape, is also indicated in scrofulous cases, as well as in those showing a tendency to formation of pus. This can be used in either the shape of liquor calcis or sulphide of calcium, and should be continued for some time after all apparent signs of the formation of pus have disappeared.

In those cases following fever, etc., such drugs as will restore normal nutrition should be employed.

In cases of secondary syphilis, the use of liquor potassii et hydrargyi iodidi will be found beneficial in such as have a flabby condition of the muscular system, tongue red and pinched-looking. Care must be exercised in the employment of all arsenical preparations not to get the marked physiological effect of the drug, as the irritation so produced will increase the iritic symptoms. When syphilitic nodules appear the use of thuja has, in many cases, seemed to have a beneficial action.



When a mydriatic, especially atropine is used, it is imperative that the bowels be kept active. The action of atropine, besides the tendency to lessen secretion from mucous membranes, seems to be to retard peristaltic motion of the alimentary tract. Frequently one reason why jaborandi is beneficial in these cases is the action of the drug on the mucous glands, increasing their activity, thus tending to counteract the effect of the atropine. This action, as well as the tendency to promote absorption, makes the drug a valuable remedy in iritic cases.

In traumatic cases, foreign bodies, if present, should be removed. Lens matter, if there is enough to increase tension, should be evacuated. Paracentesis or iridectomy may be required.

In sympathetic iritis and so-called serous iritis, atropine or any mydriatic must be carefully used, as in some cases the tendency is to increase the difficulty. It is usually better to use a mydriatic once or twice a day (not a very strong solution), and to use a myotic, eserine, two or three times a day. Rest, in these cases should be insisted upon, as it is of the utmost importance. In serous iritis, gelsemium is of undoubted value, although better effects will be obtained by combining it with jaborandi. Bichromate of potassium is also a valuable drug in this form of iritis when the characteristic punctate appearance is present. Bryonia also should be thought of, as its effect on serous tissues is always kindly.

In all forms of iritis, with possibly the exception of the chronic or tuberculous types, quiet must be insisted upon.

The advisability of bandaging the eye is important. When there is increased lachrymation, the effect of bandaging will be to retain secretion, macerating the tissues, and it may, in some cases, produce a poultice effect; this is to be avoided under all circumstances. Protection of the eye from bright light may be, and usually is required, but this is best done by plano-lenses, tinted enough to modify the light; any yellowish tint should be avoided, as this color seems to be irri-

tating. A moderate amount of light seems to be in the majority of cases a benefit to the diseased eye. The application of heat or cold cannot arbitrarily be determined. In traumatic cases cold is generally beneficial. In cases where the cornea is affected, heat is in nearly every case best. The relief or aggravation of the symptoms, as a rule, are better known by the patient, and one can generally be guided by their sensations. In some the alternation of heat and cold will be best; the utmost care in using hot applications is required, as a poultice effect will probably produce complications that will be difficult to combat.

The time-honored method of blood-letting or leeches, is of very doubtful importance; the administration of a brisk saline cathartic will do all that these methods will do, and besides will place the alimentary canal in condition to receive and distribute nourishment much better than by blood-letting. Blisters are another abomination in these cases, and usually give simply another lesion to look after.

Opiates are of doubtful importance, if a mydriatic is not contra-indicated, full dilatation of the pupil and the proper selected remedy internally, will make the use of an opiate unnecessary. The brisk cathartic is usually more potent for good than opiates, and besides will not complicate matters by placing the patient in a stupor.

Hot baths are useful in secondary syphilis, rheumatism and gonorrheal cases, but in persons with a debilitated condition, they may further lower vitality, and a chronic type may result.

*Recapitulation.*—Mydriatics, unless contra-indicated, in all types. Generally in sympathetic and serous cases the use of these drugs is contra-indicated. Cold applications in traumatic cases and in others where the measure is grateful to the patient, unless the corneal tissues are implicated.

Hot applications usually in rheumatic cases. When the maximum of relief is obtained from their use, alternate heat and cold.



Internally aconite in acute cases ; rhus tox. when motion affords relief. Bryonia when quiet affords relief, as well as when there is a serous deposit in the aqueous or vitreous. Cimicifuga when the tissues feel bruised. These remedies are frequently indicated in rheumatic types as well. Jabobrandi where exudation occurs, also where there is dryness of the mucous surfaces ; and a dry condition of the skin may also be regarded as an indication for this drug. Iodide of potassium or other iodides, in secondary syphilis, given until the physiological effect of the drug is obtained.

In rheumatic cases, the iodide of potassium should be given with the pale leaden hue of the tongue and mucous membrane of the mouth, and where there is no irritable condition of the alimentary canal. Corrosive chloride of mercury or red iodide of mercury, in small doses, will be found valuable in secondary stages of syphilis, but seldom in the tertiary stage. Salicylic acid, or the salicylates, will be found valuable in some forms of the rheumatic type, but the drug should be the true acid, not the synthetic. The tongue full, moist, purplish or leaden color, is the usual indication. Prof. F. J. Locke gives as a positive contra-indication, the pointed red tongue.

In gouty forms colchicum, when there is swelling of the joints. Calcium, either liquor calcis or sulphide of calcium, with a tendency to the formation of pus or purulent secretion.

With the stinging pain, lids and conjunctiva somewhat edematous, apsis ; and with the lids and conjunctiva considerably edematous, apyridum.

In the so-called malarial types, sulphate of quinine in full doses is indicated when there is not an irritable condition of the nerves or alimentary system, the tongue being moist and clean, skin moist and soft. Liquor potassii arsenitis in those cases having a dry inelastic skin, tongue pale, inexpressiveness, tissues flabby, and general debility of both the cerebral and sympathetic systems. In scrofulous and tuber-

cular cases, attention to the general health and use of liquor potassii arsenitis, or with anemia, iodide of arsenic. In these cases as a rule the disease is most likely to assume the chronic type, and a moderate amount of exercise should also be prescribed, the patient not being allowed to over-exert.

Liquor calcis or sulphide of calcium, is nearly always required in scrofulous subjects.

In the latter stages of syphilis, where iritis is found, chloride of gold and sodium is especially valuable; it should be used in those cases having a moderately red tongue, and capillary circulation fairly good, but must be used in small doses, from gr. 1-200 to gr. 1-100, to prevent extreme irritation. It is especially valuable in the so-called serous type.

In cases where there is marked and continued increased tension, paracentesis or iridectomy may be indicated. In sympathetic iritis, the probability of an enucleation having to be performed, must be borne in mind.

DEGENERATION OF THE IRIS.—A secondary process following chronic diseases of the iris or other tissues of the eye. When due to long continued inflammatory action of the iris *iridoncosis* is the term given to the condition. There is often thinning of the tissue, and this may be sufficient to allow light to pass through at one or more points. This is more likely to occur after the absorption of syphilitic or tubercular nodes. Following glaucoma, especially where vision has been destroyed by increased tension, this degenerative change is often noticed.

Calcareous or osseous deposits are also sometimes found in cases of degeneration of the iris.

ECTROPIA OF THE UVEA.—This is a congenital condition. The uveal pigment instead of forming a ring around the pupillary margin of the iris, projects into the anterior chamber. The color is chocolate brown, and the projections are usually seen at the upper and lower margins. This condition is natural in the eye of the horse, and some other



animals; in man it is evidently a reversion in type to primitive forms.

**TUMORS (Melanoma).**—This is a condition due to proliferation of the iris stroma. The growths are small and dark colored. They are uncommon and usually are benign, but may be the starting point of melanotic sarcomata. Probably always congenital.

**LEPROSY NODULES.**—These have been found on the iris, following leprosy of the cornea. Inflammatory action usually follows their appearance.

*Prognosis.*—Bad.

**CYSTIC TUMORS.**—Serous cysts may develop in the iris, and are generally the result of an injury. They may not develop for months after the traumatism. The walls of the cyst are transparent and lined with pavement epithelium. The cysts may be small, or grow to such a size as to fill the anterior chamber. They are seldom multiple. Irido-choroiditis, sympathetic ophthalmia or glaucoma may result from this condition.

*Treatment.*—The growth should, if possible, be removed by an iridectomy, the tissue removed, including not only the morbid mass, but also some of the surrounding healthy iris.

Epidermoid cysts are sometimes seen. They resemble a small seed-pearl, and may start from any point of the iris. The growth is slow, but eventually they produce symptoms similar to those of cystic growths. In rare instances either form of cysts appears to be congenital. The method of removing the latter form is similar to that described under serous cysts.

Vascular tumors of the iris have been seen, but very rarely occur.

**TUBERCLE OF THE IRIS (Tubercular Iritis).**—This is a condition seen in childhood, the average age at which it makes its appearance being about twelve years. The nod-

ules are small, grayish red, develop at the pupillary edge, and resemble miliary growths. The nodules may disappear, leaving however posterior synechiæ, but in some instances there will be a succession of the nodes, and when this occurs there is usually a plastic iritis, or irido-cyclitis, with subsequent shrinking of the ball.

Occasionally there is seen a solitary form of tubercle, the node being yellowish, growing from the periphery of the iris and sometimes covered with smaller bodies. Usually but one eye is affected, but both may be. This manifestation may be the only one of tuberculosis, or it may be a sequence of the disease, and when it is, it is usually rapidly fatal.

*Treatment.*—Enucleation is the only treatment known at present for this condition.

**SARCOMA OF THE IRIS.**—Seldom primary. Sometimes supervenes upon melanoma of the iris. The development of the pigment growth is usually slow during the early stages, in the latter stages rapid. In this stage the pain is severe, hemorrhage occurs and the globe finally bursts. The disease seems most prevalent among females.

*Treatment.*—In the early stages when circumscribed, a broad iridectomy, so as to include the healthy iris tissue surrounding the growth, may give good results. In the latter stages however, an enucleation is the only procedure.

**LEUCO-SARCOMA.**—A nonpigmented form of iris sarcoma has been seen. It is sometimes complicated with serous iritis.

*Treatment.*—Same as just described.

Lymphomata of the iris is a very rare form of tumor.

**INJURIES OF THE IRIS.**—The iris may be injured during operative measures, as in paracentesis, cataract operations, as well as by penetrating wounds, the result of accident. A clean incision, if no other structures are injured, may not produce serious results. There will be blood in the anterior



chamber, but this is generally absorbed. As a rule however, in penetrating wounds, the lens or ciliary body is injured, and traumatic cataract or sympathetic inflammation or irritation may result. When the penetrating substance is a splinter of steel or some such article, the body may remain in the anterior chamber, iris or lens, or may penetrate into the vitreous, or it may be embedded in the retinal or choroidal coats, or if the momentum is sufficient may pass entirely through the ball, lodging in the orbital tissues. In some cases the foreign substance is driven with just enough force to partially penetrate the cornea, and in the effort to remove the offending substance it may be forced entirely through and drop into the anterior chamber or become entangled in the iris.

A foreign body should always be removed when it is possible to do so. If it is lodged in the iris or anterior chamber its removal is best effected by making a corneal incision close to the scleral border, with the broad needle or narrow keratome, and remove the foreign body with forceps, or if the substance is iron or steel, using some of the various magnets devised for this purpose. A solution of eserine should be instilled into the conjunctival sac previous to the operation. If the effort to remove the foreign body with forceps or magnet fails, the iris, including the offender should be drawn out and incised. In nervous subjects and children, general anesthesia is preferable to local. Following this operation, treatment similar to that given under iridectomy should be used.

Blows upon the eye may produce irido-dialysis, a rupture of the ciliary attachment of the iris. The rupture may be slight or considerable and give the impression of a secondary pupil at the peripheral margin. The detachment can be positively diagnosed by the red reflex under ophthalmoscopic illumination. In an injury of this character there is more or less pain, probably some dread of light and hemorrhage into the anterior chamber.

As a rule, the lesion is permanent, although if slight, full dilatation of the pupil, with a solution of atropine, may lead to union of the surfaces. If small, there is usually little discomfort, but diplopia may be present.

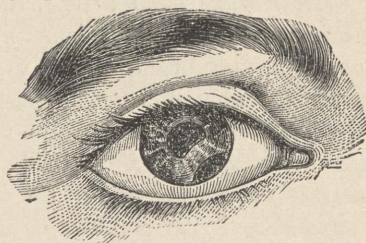


FIG. 48.—Irido-dialysis.—Noyes.

*Treatment.*—Solution of atropine and quiet.

Rupture of the sphincter may result from a blow; here the pupil will be dilated (traumatic mydriasis) and the pupillary border will present minute irregularities as a result of the traumatism. This condition is rare, and treatment seems to have no influence on the results.

Displacement of the iris is occasionally seen. (1) Retroflexion, a folding back of a portion of the iris membrane upon the ciliary processes, and nearly always with partial dislocation of the lens. (2) Anteversion, the detached portion of the iris folding forward upon itself, so the uveal or posterior surface is lying forward. (3) Aniridia, a complete detachment of the iris. It may lie in the anterior chamber or be displaced under the conjunctiva. An injury which is severe enough to produce this condition will almost invariably damage other structures of the eye and necessitate enucleation.

**FOREIGN BODIES.**—This has been treated of under the head of injuries. Sometimes a cilium may be carried into the anterior chamber by a penetrating substance, and if allowed to remain may cause a cystic tumor (implantation cyst).



Cysticercus and filaria sanguinis hominis are two parasites that have been found in the anterior chamber and iris. When discovered they should be removed, the operation not being essentially different from that already described under foreign bodies.

## CHAPTER VIII.

### DISEASES OF THE CILIARY BODY.

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The ciliary body is an important organ, as it is the active factor in the act of accommodation, and injuries as well as diseases of this structure have an important bearing on not only the integrity of the eye, but also on visual acuity. It occupies the anterior portion of the globe, but back of the iris, which is continuous with it through the pectinate ligament. The external layer of this body is the ciliary muscle, composed of two portions, the external, containing longitudinal fibers, which arise from the external fibrous tunics of the eye at the sclero-corneal junction, running backward until lost in the external layers of the choroid; this is called Brucke's portion. In the inner layer the fibers have a circular direction and are called Müller's portion. The fibers of the two divisions frequently merge into each other. This anastomosis of the fibers changes their direction by gradual gradations, so that the longitudinal take a circular direction through what are termed radial bundles.

The proportion of longitudinal and circular fibers varies, according to the ametropic condition of the eye. In hyperopia the circular fibers are strongly developed, while in the myopic they are less numerous, and in some cases nearly lacking.

Next to the inner layer of the ciliary muscle are the ciliary processes. These consist of a connective tissue stroma and branched pigment cells, and contain numerous blood-vessels.



This is the most vascular portion of the eyeball, and through this anastomosis of the blood vessels the nutrition of the anterior structure of the eye is maintained.

The inner surface of the ciliary body is covered with three layers. (1) A homogeneous membrane (hyaline lamella). (2) Pigment membrane. (3) A single layer of non-pigmented cylindrical cells, which is in contact with the vitreous. The last two layers are really a continuation of the retina. The three layers merge into the posterior surface of the iris, the hyaline being continued into the posterior limiting membrane, while the pigmented and non-pigmented cells are incorporated into the strata of iris pigment layer.

The junction of the iris and ciliary body with the sclera is important. This point is back of the sclero-corneal junction, the anterior portion of the sclera being within the border of the anterior chamber. The union of the sclera and iris is made by loose tissue arising from the corneal margin, extending back to the root of the iris. This tissue is the *ligamentum pectinatum*, and fills the angle between the iris and corneo-sclera, rounding it off into a sinus—sinus of the anterior chamber.

The pectinate ligament is composed of superimposed layers, starting from the margin of Descemet's membrane, running backward to where part of the longitudinal fibers of the ciliary muscle is contiguous with them. This is a cribriform and spongy tissue. The iris dividing the aqueous space forms the anterior chambers of the eye.

Embryologically, the uvea consists of the choroid, ciliary body, iris, pectinate ligament and Descemet's membrane. This close anatomical relation explains the spread of inflammatory action, and also the danger to the integrity of the eye when the ciliary region is injured.

**CYCLITIS.**—This is a term applied to inflammatory action of the ciliary body. As already stated, the ciliary body is frequently associated with morbid changes in the choroid, iris, etc.

*Symptoms.*—The general line of symptoms are, pericorneal injection, neuralgic pain, tenderness on pressure over the ciliary region, turbidity of the aqueous; exudation on the posterior layer of the cornea, at times hypopyon; exudation into the pupillary space, and often exudation into the posterior chamber, causing more or less complete synechiæ, which when complete produces a deepening of the anterior chamber; exudation into the vitreous with resulting opacities, which usually are in the anterior layers; change in the tension of the ball, either increased or diminished.

In acute cases besides the symptoms given, there will be photophobia, increased lachrymation, and diminution of vision in proportion to the amount of exudate into the pupillary space, aqueous or vitreous.

DIFFERENTIAL DIAGNOSIS BETWEEN SIMPLE IRITIS AND IRIDO-CYCLITIS.—*Fuchs.*

IRITIS.

1. Absence of usual inflammatory phenomena.
2. No decided tenderness on pressure.
3. No distinct change in the anterior chamber; only slight turbidity of aqueous.
4. Vision diminished in proportion to turbidity of aqueous.
5. Unaltered intra-ocular tension.

IRIDO-CYCLITIS.

1. Severe inflammatory phenomena, edema of upper lid.
2. Distinct tenderness on pressure.
3. Precipitates in the cornea; retraction of the periphery or the iris by total posterior synechiæ, and deepening of the anterior chamber.
4. Marked lessening of visual acuity due to opacities in the vitreous.
5. Tension altered—lowered or raised.

VARIETIES OF CYCLITIS.—Usually three divisions are given; simple or plastic, serous and purulent.

SIMPLE OR PLASTIC CYCLITIS.—Pericorneal injection marked, and severe pain in ciliary region. The veins of the iris dilated, and through the action of the plastic exudation in the ciliary body, the periphery of the iris is retracted, the



pupil dilated, or there is deepening of the anterior chamber. Extension of the inflammatory action may result in iritis or choroiditis, with formation of vitreous opacities.

**SEROUS CYCLITIS.**—In this form the pericorneal redness is not so marked, and pain is less severe. The symptoms are the same as given under serous iritis and punctate keratitis. Marked diminution of vision and formation of fine vitreous opacities in the anterior portion, usually quickly supervene. The iris and often the choroid are implicated. Increased tension results, and symptoms of glaucoma present.

**PURULENT CYCLITIS.**—Very marked pericorneal injection, ciliary pain extreme, and edema of the conjunctiva and upper lid usually present. Large vitreous opacities and hypopyon—the latter condition may be recurrent—are nearly always present in this form. Implication of the iris and choroid usually present; purulent and parenchymatous types if the iris, and suppurative if the choroidal tissue is affected.

*Course and Sequelæ.*—Prompt and early treatment in cyclitis may result in cure with useful vision, but seldom with the acuity present prior to the attack. The serous form is especially liable to provoke glaucoma. The purulent, or the plastic variety which becomes purulent, will frequently be followed by atrophy of the iris and choroid.

Detachment of the retina may follow through shrinking of a vitreous which has become filled with organic opacities; the lens becomes opaque and the eyeball may shrink; this is usually termed *phthisis bulbi*. When the original inflammatory action has been of the plastic type, a chronic condition may remain, often shrinking of the eyeball has occurred, the ball remaining sensitive and readily inflamed, and a sympathetic inflammation of the fellow eye resulting. The disease may not yield readily to treatment, being as a rule extremely tedious in its course.

*Causes.*—Injuries are common causes of this disease, either accidental or operative, e. g., as in cataract extraction.

Syphilis seems to have a predilection for the ciliary body. Hereditary gout and rheumatism have also been given as causes. Primary and uncomplicated cyclitis is seldom seen, but results from diseases of contiguous structures.

*Prognosis.*—Always serious.

*Treatment.*—Will vary according to the type. Local—in the plastic form, a mydriatic is usually indicated although a myotic is sometimes required, or the drugs are used alternately. In the serous form mydriatics are usually contra-indicated, and in the purulent form are frequently contra-indicated. The application of heat or cold, usually the former will be found to give the greatest amount of relief

Internally in any of the forms, if the inflammatory action is active, aconite in doses of gtt. 1-5 to 1-3, every one or two hours. With stinging pain, edema of the conjunctiva or lids, apis; if the edema is considerable, apocynum. When motion of the globe gives relief, rhus tox. With tissues feeling bruised, cimicifuga. Swelling of the joints, in acute or sub-acute rheumatic or gouty conditions, colchicum; the salicylates may also be used in these forms. When the skin is dry and harsh, with the mucous membranes also dry, showing lack of secretion, jaborandi. Calcium, where there is a tendency to formation of pus, as shown by hypopyon, or those cases in which traumatism of the skin are usually followed by formation of pus, will also be benefited by the use of lime. In anemic patients, especially of a syphilitic character, iodide of arsenic. In syphilitic patients with swelling of the lymphatic glands, phytolacca, and when there seems to be a lack of glandular activity, iris versicolor may be given either alone or in combination with phytolacca. Iodide of potassium, in cases of syphilitic history, and if they have not been over-loaded with mercury, some of the mercurial preparations. Red iodide of mercury in about 1-100 gr. doses, will be found useful in the acquired type of the disease, especially the secondary period. Bichromate of potassium is also useful



in specific cases, in which the serous form predominates; in these cases there will usually be a tenacious, tough, stringy secretion, not only from the mucous surfaces of the eye, but also from the nose and throat. Another remedy which must not be overlooked in the serous form, is bryonia, more especially in those cases having the fine vitreous opacities, and also where quiet seems to relieve the pain; here as in inflammatory conditions of the eye, the use of cathartics is important, and as a rule the salines are preferable.

**INJURIES OF THE CILIARY BODY.**—As already stated, perforating injuries of the sclera are always serious, "the dangerous zone" is the space 1-4 in. wide surrounding the cornea. A plastic cyclitis or sympathetic ophthalmia, as a result of injuries in this region are to be watched for. A penetrating wound in this region is always a menace to the eye.

The choice between conservative and radical measures must be determined by the nature of the injury, and the probability of infection.

The treatment given under scleral wounds should be followed if deemed advisable, otherwise an enucleation or evisceration should be performed, before sympathetic inflammation supervenes, as the sympathizing eye seldom returns to normal in acuity of vision.

**TUMORS OF THE CILIARY BODY.**—These morbid growths may partake of the characteristics of nearly any growth.

Sarcoma, myxo-sarcoma, adenoma, primary epithelial growths, carcinoma and squamata, may occur in these structures and spread to adjacent tissues. Ossification has been noted as well as myoma. Cysts and nevi are also sometimes seen.

*Treatment.*—Conservative treatment in these cases is generally useless. The most conservative is the removal of the globe, and in many cases, of more or less of the orbital tissue.

IRIDO-CHOROIDITIS (Cyclitis with Disease of the Vitreous and Keratitis Punctata; Chronic Serous Irido-Choroiditis).—Under these headings are two types depending upon whether the disease is primarily in the iris or choroid. In the first form there is mild iritis, little pain, ciliary congestion slight, not much deepening of the anterior chamber, and with some deposit on the posterior layer of the cornea, as in serous iritis. A persistent chronic inflammation is present with frequent relapses. Exudation behind the iris results and the pupillary margin adheres to the anterior lens capsule, so the surface is irregular or completely bulged forward. Floating opacities in the vitreous can be discerned by ophthalmoscopic examination, unless the pupil is occluded. When this condition occurs the tension may be increased and secondary glaucoma result.

In the second form the morbid process passes from the choroid forward. There will be choroidal patches, which increase in extent and depth, eventually interfering with the nutrition of the vitreous, which will contain opacities. The lens becomes affected and pushed forward, the iris is involved in a plastic inflammation, the anterior chamber narrowed and diminution of vision results. Eventually the lens becomes opaque, the eyeball softens, detachment of the retina may follow and the ball finally shrink.

The disease is essentially chronic and those cases in which the symptoms are confined to the iris are very insidious.

*Causes.*—The disease is most frequently seen in young adults. Inherited gout, rheumatism and syphilis are accredited as exciting factors. Malnutrition in the female and menstrual disturbances seem to be exciting causes in some instances. Nervous and physical exhaustion, especially combined with loss of sleep, has undoubtedly produced this condition in some cases. In many cases however it is impossible to assign any cause.

Synechiæ, from former iritic inflammation, has been considered the cause in some instances.



*Prognosis.*—Always guarded. When the case is seen early, a cure may follow proper treatment, but the danger of glaucoma or atrophy of the ball must be remembered.

*Treatment.*—Local. In the early stages atropine, unless there is increased tension. Increased tension without synechiæ calls for eserine. In some cases the use of both drugs may be required, but care must be exercised in the use of them in this type of disease.

*Internally.*—During the active stage, aconite ; where motion seems to relieve, rhus ; with edema of the tissues, apis or apocynum ; where quiet seems to give relief, bryonia ; bruised sensation of tissues, cimicifuga ; gouty condition, colchicum. Iodide of potassium, in specific cases or rheumatic cases, where the indications for the drug are present. Bichromate of potassium, with the punctate appearance of the cornea. In anemic cases, iodide of arsenic ; when a suppurative condition is present, calcium, either in the shape of aqua calcis or sulphide of calcium.

Operative measures may be necessary in cases with increased tension and firm posterior synechiæ ; a broad iridectomy will restore communication between the anterior and posterior chambers. Extraction of the lens may also be done at this time, if it is opaque. When the visual field is normal or nearly so, an iridectomy will, in some cases, give good results, even after the eyeball has commenced softening.

SYMPATHETIC IRRITATION, SYMPATHETIC INFLAMMATION, SYMPATHETIC OPHTHALMIA.—When a healthy eye becomes involved as the result of injury or disease of the other eye, these terms are applied, depending on the character of the disturbance.

CAUSATIVE AFFECTIONS PRODUCING SYMPATHETIC CHANGES.—(1) Wounds of the ciliary region producing traumatic irido-cyclitis. It is said that 80 per cent. of these cases are the result of traumatism. (2) Foreign bodies in the eye. (3) Perforation of the cornea with incarceration of the iris,

or cicatrices involving the ciliary body. (4) Operations, as cataract extraction, sclerotomy, iridodesis, iridectomy, dissection or reclinatio where practiced. (5) Calcification or luxation of the lens. (6) Intra-ocular tumors in conjunction with irido-cyclitis. (7) Ossification and calcification of the choroid and ciliary body. (8) Pressure of an artificial eye or incarceration of the stump of the optic nerve in cicatricial tissue following enucleation. (9) Herpes zoster ophthalmicus, intra-ocular cysticercus, symblepharon, sub-conjunctival rupture of the globe (without associate irido-cyclitis) or spontaneous inflammation of one eye. Any of these conditions, it is claimed, may excite sympathetic irritation.

**SYMPATHETIC IRRITATION** (Sympathetic Neurosis). A functional condition presenting a line of symptoms in which photophobia, lachrymation, blepharospasm, disturbances of accommodation, diminished visual acuity, inability to use the eyes for close work, neuralgic pain following the distribution of the supra-orbital nerve, photopsia (flash of light), contracted visual field and hyperemia of the retina and optic disk, and tenderness on pressure over the ciliary region, any or the majority of which symptoms may be present. It is a safe rule in taking care of an eye which may produce sympathetic disturbances in the other eye, to look for tenderness in the ciliary region, and to watch the accommodative power, and also for a decided tendency to recurrence of any of the above symptoms. The removal of the exciting eye or exciting cause will probably relieve the condition.

*Symptoms in the Exciting Eye.*—An eye which may cause sympathetic irritation is liable to show, during the attack, congestion of the ciliary region, photophobia, lachrymation, neuralgic pain and tenderness on pressure. These symptoms may subside at the commencement of or during the course of sympathetic irritation in the fellow eye, recurring from time to time. Sympathetic irritation may also result from a minor lesion, as an undetected foreign body in the conjunctival cul-de-sac.



No invariable line of symptoms prevail, although there may be an iritis or irido-cyclitis, congestion and change of tension, but pain may be absent, hence will escape observation. If the exciting eye is not blind there will be diminution of vision.

**SYMPATHETIC INFLAMMATION** (Sympathetic Ophthalmia).—Different forms occur. It may follow an attack of irritation or even be co-existent with it, but is often seen without any premonitory symptoms of this kind. Patients having sympathetic irritation should always be warned of the serious danger to the eye. Marked oscillation of the iris has been given as a frequent condition when sympathetic irritation is about to merge into inflammation. Sympathetic ophthalmitis, or as it is the uveal tract that is involved, more properly sympathetic uveitis, may make its appearance with or without any warning. It may present—

(1) As irido-cyclitis, either plastic or malignant.

(2) As serous iritis. Aqueous turbid, deepened anterior chamber, punctate dots on the posterior corneal surface, increased tension, slight ciliary injection, and some opacity in the anterior vitreous layers. Plastic iritis or irido-cyclitis may result. In many cases papillo-retinitis is present, and this condition has been given as the primary affection.

(3) As choroido-retinitis. Hazy outline of the papilla, edematous retina, tortuous and dilated retinal veins, and a slight serous iritis may also present. This form is seldom seen.

In the sympathizing eye these symptoms may be either acute or chronic. Often insidious in character, they may not be recognized by either patient or physician until serious damage has resulted. When a case presents in which sympathetic irritation or inflammation is liable to occur, an important premonitory symptom to be remembered is tenderness in the ciliary region, often circumscribed, which can be demonstrated with the end of a probe. When this spot is touched the patient will shrink from the contact. This is

an almost characteristic condition. An identical point of tenderness in the ciliary region may also exist in the exciting eye.

*Symptoms.*—Pain, photophobia, pericorneal redness, change in color of iris, pupillary space closed by exudation around its margin and behind the iris, tenderness in the ciliary region, narrowed anterior chamber, vitreous effusion, opaqueness of the lens, detachment of the retina and eventually atrophy of the eyeball.

*Period of Incubation.*—Sympathetic irritation may develop within forty-eight hours, or may not show inside of five or six days. Sympathetic inflammation does not occur nearly as soon; as a rule, it is from three to six weeks after the disease or injury to the exciting eye. In a few cases it has been seen as early as the fourteenth day, and sometimes years may elapse before the disease makes its appearance.

*Causes and Pathology of Sympathetic Ophthalmia.*—Various theories have been advanced, but the question has not been satisfactorily settled. The term sympathetic was given under the impression that it was a reflex action through the ciliary nerves. Another theory is that the continuity of tissue through the optic nerve apparatus is responsible for the transmission from one eye to the other.

*Treatment.*—The most important factor is of course the primary lesion. The location and character of the wound, or stage of the disease, and the amount of vision in the eye must be considered. If traumatic, the directions given under scleral wounds are sufficient. A careful consideration of each case is imperative, as after sympathetic ophthalmitis, the change which has taken place can seldom be benefited.

The following rules for operating are the most generally accepted as giving the best results. Enucleation, or some of its substitutes, of the eye:—

1. When a wound involves the ciliary region and is severe enough to immediately destroy sight, or when the probabili-



ties are that its destruction is reasonably certain through inflammatory action on the iris or ciliary body.

2 A wound involving the ciliary region when the complication of inflammation of the iris or ciliary body already exists, even if sight is not destroyed; or when after careful efforts for its removal have been carefully made, a foreign body remains in the globe and a severe iritis is present.

3 When vision has been destroyed by plastic irido-cyclitis, or the eyeball is atropied, and there is tenderness in the ciliary region on pressure as well as recurring attacks.

4 Where the vision has been destroyed, even when sympathetic inflammation has commenced. This measure in all probability will not restore lost vision in the sympathetic eye, but may check further loss.

5 In wounds involving the cornea, iris or ciliary body, whether the lens is injured or not, when persistent sympathetic irritation has occurred, or when it is recurrent.

6 When primarily lost by an injury, or atrophy has occurred and there are symptoms of sympathetic irritation.

It is conceded that the enucleation of the injured eye in which vision cannot be restored is the best preventative of sympathetic ophthalmitis. It must be remembered however, that this procedure does not always prevent the fellow eye from being affected, as the morbid process may have commenced early, and the diseased condition may manifest itself later. Evisceration has been advocated instead of enucleation, but the results have not been more favorable. Resection of the optic nerve (neurectomy) has not proven preventative, but may be tried when the patient refuses enucleation. In an exciting eye where there is vision, and sympathetic inflammation has commenced, an enucleation must not be performed, as the exciting eye may possibly be the best after the subsidence of the disease.

*Treatment.*—The treatment given under iritis and irido-cyclitis should be followed in these cases. In the sympathizing eye, operative measures are generally harmful.

However, when the tension is very much above normal and is persistent a sclerotomy may be necessary. The use of mydriatics, unless there are contra-indications existing, should be employed as in iritis. The employment of intra-ocular or sub-conjunctival injections should not be made. If the methods of treatment given under iritis and irido-cyclitis are followed, as good results will be obtained as it is possible to get, but they are not eminently satisfactory. Useful vision, not normal however, may result; but phthisis bulbi as well as complete annular adhesions to the anterior lens capsule may follow, the lens having probably become cataractous.

Operative measures for this condition are generally unsuccessful. In young subjects a double needle operation has been advised. See operations.

*Prognosis.*—Always bad. In a few cases good recovery has taken place, in which neuro-retinitis was present. When neuro-cyclitis or irido-choroiditis appears, the ball shrinks and vision is lost. The serous iritis type seems to be the most favorable. The patient should always be advised of the gravity of the disease, and any measures undertaken should be only after the probable outcome is fully explained and understood. Under no circumstances should the care of such a case be undertaken unless the patient can be under daily observation.



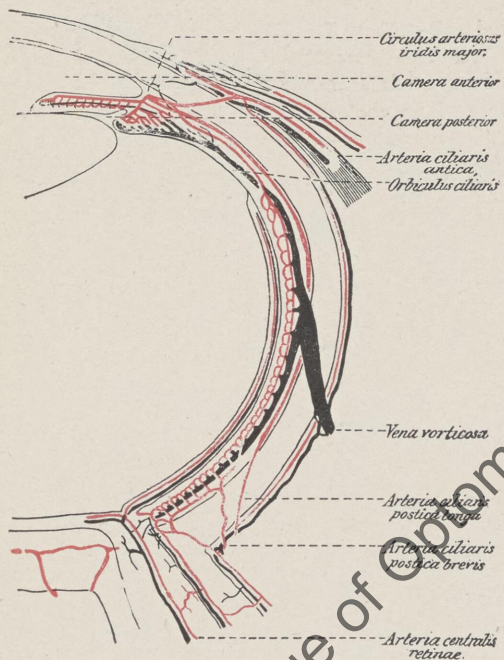


FIG. 11.

Blood-vessels of the Eye. Arteries, red; Veins, black.

(Fick)

## CHAPTER IX.

### DISEASES OF THE CHOROID.

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The choroid consists of that portion of the middle vascular tunic lining the posterior portion of the ball from the ora serrata to the optic nerve aperture. At these two places the choroid and sclera are firmly united. At the points where perforating blood-vessels and nerve-trunks pass from the sclera to the choroid, there exist more or less firm attachments, the most marked being the region of the posterior ciliary arteries and the venæ vorticosæ. (See Fig. 50.)

The number of layers composing the choroid varies from three to five according to various writers. This variation depends upon whether the change in the size of the blood vessels is counted or not. The structure of the choroid is a more or less compact connective tissue stroma, containing numerous blood vessels arranged more or less into three layers, the larger vessels externally and the smaller internally, the chorio-capillaris.

The retina and vitreous receiving nourishment from the choroid, this arrangement of the vessels is necessary. Between the external, or layer of the larger bloodvessels and the sclera is sometimes given a non-vascular layer—supra-choroidea. Branched pigment cells are contained in all the choroidal structures, excepting the capillary layer and lamina vitrea. The dark brown color of the choroid is due to this abundant pigment supply.



The lamina vitrea, glassy lamina, vitreous membrane or membrane of Bruch, is the inner layer of the choroid, separating the chorio-capillaris from the external retinal layer. This lamella consists of a homogeneous, non-vascular membrane, which, according to some investigators, is divided into two portions, the outer containing no pigment and closely

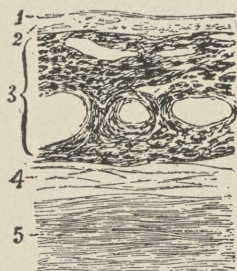


FIG. 51.—Section through the Choroid—*Kirke*.

1, Elastic membrane, structureless or finely fibrillated; 2, chorio-capillaris; 3, substance of the choroid with large vessels cut through; 4, suprachoroidea; 5, sclera.

united to the capillary layer, while the inner consists of delicate interlacing trabeculæ, containing pigment epithelium. According to Fuchs however, this division really belongs to the retina; "it consists of regular hexagonal cells, each of which contains a pigmented nucleus, while the protospasm contains abundance of pigment granules."

**NERVES.**—The nerve supply appears to be vaso-motor, as they are distributed to the muscular tissues of the blood-vessels.

The nerves are derived from the long and short ciliary nerves. The choroidal branches consist of both medullated and non-medullated fibers, which form a dense plexus, especially in the ciliary muscle, where are situated ganglion cells, which are found along the choroidal vessels. Sensory nerves seem to be lacking in the choroidal region, as inflammatory diseases here do not produce the sensation of pain.

**BLOOD-VESSELS.**—The blood-vessels consist principally of branches from the short ciliary arteries and the collecting veins. (See Fig. 52.)

DIAGRAMMATIC HORIZONTAL SECTION OF EYEBALL AND ORBIT.  
(After Fuchs, much modified.)

Periorbital *green*; muscle-fascia *red*; Tenon's capsule *yellow*.

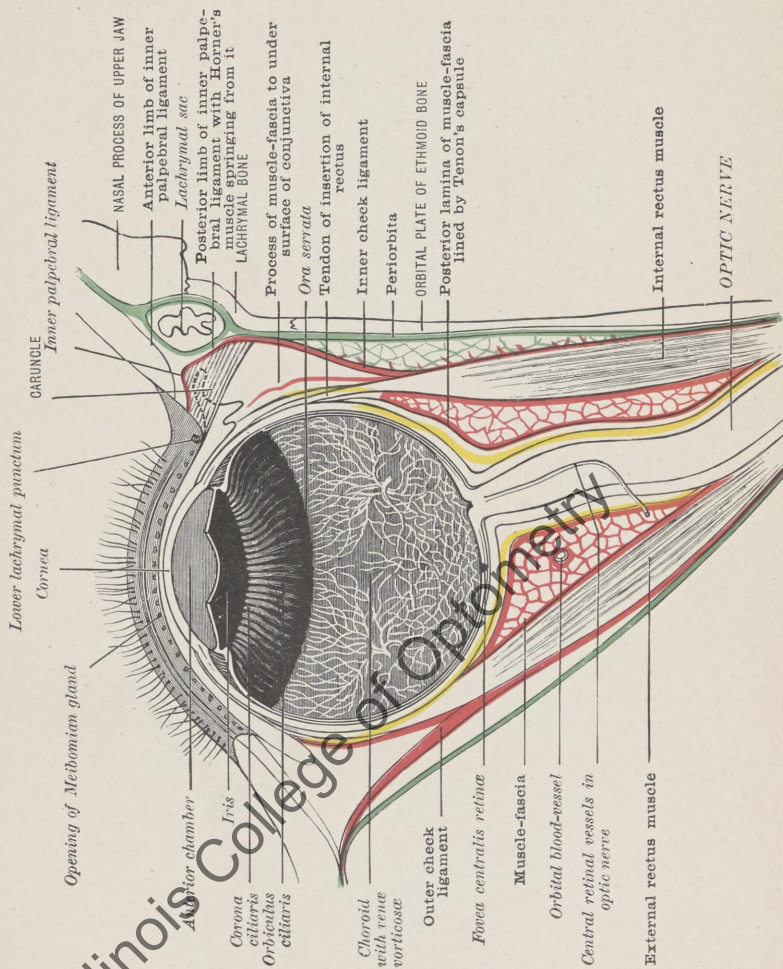


FIG. 52.

(Morris)



LYMPHATICS.—The lymph supply to this region is conducted by distinct capillaries, which are in close communication with lymph spaces in the chorio-capillaris and the larger lymph channels of the outer structures.

ANOMALIES OF THE CHOROID.—Congenital anomalies are due to defective development in the region of the choroidal fissure and macula; it may be a coloboma, defective pigmentation or a vascular defect.

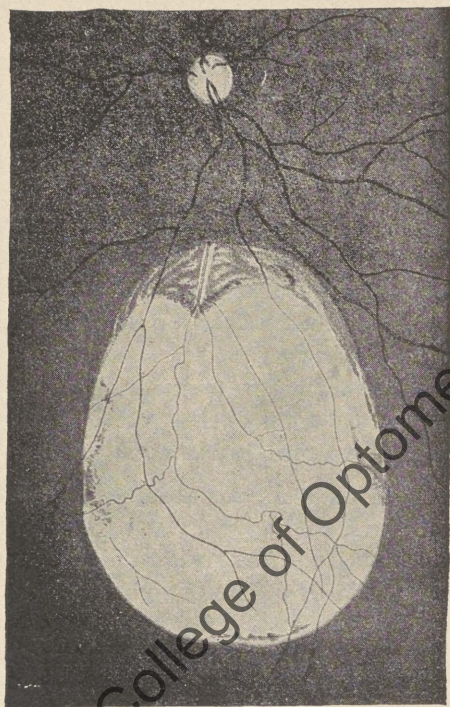


FIG. 53.—Coloboma of Choroid. A large oval patch in the lower part of the fundus. At the upper margin some of the choroid is seen. The retinal vessels pass over the coloboma.—Haab.

COLOBOMA OF THE CHOROID.—This defect is usually in the lower portion of the globe, ovoid in shape, and consists

of an absence of choroidal tissue. This defect may extend up to or even beyond the optic disk, in which case there would also be a coloboma of the optic nerve sheath, the normal appearance of the disk being lost. Coloboma of the iris and ciliary body frequently occurs in these cases. Owing to the absence of the choroid, the examination with the ophthalmoscope will reveal a pearly-white area with irregular edges, as a rule, the edges being sharply defined and pigmented.

The surface may be covered by the retina or it may be absent. When the retina is present it will appear as a nearly transparent veil over the choroidal defect. There is a marked hereditary tendency present in these cases. It is probable that this condition is due to an abnormal adhesion of the retina to the mesoblast. This will explain those cases where the retina covers the area, as well as the frequency of this defect in the region of the retinal fissure. Coloboma is also sometimes found in the macular region (macular coloboma) and occasionally in the nasal portion of the eye ground (extra-papillary coloboma).

Fuchs' coloboma consists of a small crescentic choroidal defect at the lower border of the optic disk, resembling the myopic crescent, excepting in its position.

ALBINISM.—This is due to congenital lack of pigmentation in both the choroid and iris and is found both as complete and incomplete. The iris has a pink or pinkish-yellow color caused by the reflection of light from its own blood-vessels, as well as from the choroidal vessels. As a rule, these cases lack pigment in the hair, and usually nystagmus, amblyopia and refractive defects are marked. Whether heredity is a factor or not is a question.

#### OPHTHALMOSCOPIC PICTURE OF THE NORMAL CHOROID.

—The portion visible by means of the ophthalmoscope is the posterior part. The appearance varies according to the amount of pigment in the retina and choroidal stroma. As



a rule, persons having dark complexions and hair, will have more pigment in these structures, and the fundus presents a uniform brick-red or brownish-red color, and the choroidal vessels are not discernible. A stippled appearance of the surface is generally seen by direct ophthalmoscopic examination. If the retinal pigment is slight or absent, but pigment is present in the choroid, a "tiger-skin" fundus appears, the larger choroidal vessels showing as curved red lines, with a dark-brown intervening space. In very fair persons, when the pigment in the retina and choroid is slight or absent, the albino fundus is seen. Here the choroidal vessels are visible and the intervening spaces are pale on account of the sclera showing through the transparent structures.

Intermediate types are found, and in the same eye there may be marked differences in the fundus, and yet no abnormal condition be present. Independent of complexion, the vessels of the choroid are more plainly distinguished in myopia than in any other refractive condition, and also are more marked in old people than in young.

In high degrees of astigmatism, the choroidal portion corresponding to the meridian of greatest curvature generally shows the vessels; in the myopic meridian of mixed astigmatism this is especially noticeable.

The choroidal vessels are recognized by being flat, tape-like in form, uniform light red color, absence of central light streak, greater tortuosity, and the larger dividing into a number of branches at one point. If they are crossed by retinal vessels, the choroidal ones are seen posteriorly.

The ability to distinguish between normal and abnormal types of fundus must be obtained by repeated and careful use of the ophthalmoscope.

**HYPEREMIA OF THE CHOROID.**—This is a doubtful classification, but may be assumed when the optic disk shows a distinct redness and there is difficulty in differentiating between the disk and surrounding choroid, which is unduly

reddened. This condition is common in "eye strain," or in eyes exposed to intense light or heat.

*Symptoms.*—Aching of the eyes, intolerance of light, especially artificial, and marked asthenopia.

*Treatment.*—Rest of the eyes, the use of a mydriatic and protection from bright light by suitable colored glasses, not too dark. Internally Lloyd's ergot in doses of gtt. ij to v every four hours. Pulsatilla when there is an apprehensive condition. But the main reliance is rest.

CHOROIDITIS.—Under this heading are included inflammatory conditions, which may be (1) idiopathic, (2) symptomatic of diseases of other portions of the uveal tract or constitutional diseases, (3) traumatic.

*Symptoms.*—Usually only an ophthalmoscopic examination will reveal choroidal changes. The appearance of the fundus is modified by (1) absorption of pigment epithelium, (2) areas of pale yellow color, with shading off into the choroid, the result of exudate (recent choroiditis), (3) white areas, the result of exposure of the sclera (atrophic choroiditis), (4) black pigment patches, distributed over the fundus, generally bounding the atrophic spots, and varying in shape.

Excepting in the acute or purulent forms, where the morbid process is not confined to the choroid and there is injection and chemosis of the conjunctiva, there are no external manifestations of deep seated disease.

A secondary result of disease of the choroid may be opacities in the vitreous or lens.

Subjective symptoms peculiar to choroiditis are absent. Pain is seldom present excepting in purulent forms or when iritis is a complication. Impairment of vision depends upon the location of the lesion and the amount of atrophy. When the morbid process is peripheral, visual acuity may not be affected; if however, the macular region is affected, sight may be very much diminished or practically destroyed. In some cases of extensive diffuse choroiditis however, good



vision may be retained. When secondary changes in the lens or vitreous result from choroiditis there will be further diminution of vision. Positive and negative scotoma may be present. Contraction of the visual field is found in some types of the disease, especially when secondary atrophy of the optic nerve follows.

*Diagnosis.*—Easily made by ophthalmoscopic examination, the changes before given being remembered. In many cases a secondary retinitis complicates the disease, and difficulty is experienced in determining the location of the pigment. If a retinal vessel crosses the pigment and the mass appears to be in a deeper layer, the location is supposed to be in the choroid; if the mass covers a retinal vessel and appears to be in front of it, the position is on the inner surface of the retina and shows secondary retinitis. A "lace-like pattern" or bone-corpuscle appearance is always in the retina, according to Nettleship. Both positions of pigment are often found in the same eye.

*Course.*—Choroiditis may appear suddenly and be acute, but the rule is for an insidious chronic type. The acute form may be confined to the posterior pole, resulting in permanent myopia, or it may assume a purulent type. The chronic form usually begins with an exudation or hemorrhage, passing gradually through the stages of absorption, atrophy and pigmentation. The latter appearances demonstrate former attacks, and the term "old choroiditis" or "choroido-retinitis" is given.

*Complications.*—Through proximity, the following structures are often implicated: the retina, through continuity by means of the pigment epithelium, is probably always implicated, and through this close association the term choroido-retinitis or retina-choroiditis is given; the optic nerve, (choroiditic atrophy); vitreous (vitreous opacities); lens (posterior polar cataract); iris (irido-choroiditis); and the sclera (sclero-choroiditis) are found.

*Prognosis.*—Always guarded. If the position of the mor-



bid process is in the macular region, the resulting vision is necessarily bad, and even in other cases blindness may result. Prompt and careful treatment may preserve sight, but visual acuity is much lessened.

Besides the acute and chronic form of choroiditis, a further division is made into plastic, serous, and purulent. If the cause of the disease is positively known it is then usually designated, e. g., syphilitic choroiditis. For the sake of simplicity however, the divisions of superficial and deep will be made, which will include the other recognized types. They are non-suppurative exudative choroiditis, suppurative choroiditis and irido-choroiditis.

**SUPERFICIAL CHOROIDITIS (Epithelial Choroiditis).—**In this condition the normal ophthalmoscopic picture is changed, the choroidal vessels may be distinguished as moderately broad, reddish, or yellow-red bands, which have the appearance of interlacing. The intervacular spaces are dark colored and may be lozenge-shaped. This condition results from absorption of the pigment epithelium and the capillary layer beneath it.

Not infrequently toward the periphery of the choroid, the same appearance may be noticed in an otherwise healthy eye, especially in the lower and inner-nasal portion, which is a physiological condition.

The morbid process may include the entire fundus with the exception of the macular region, when the ophthalmoscopic picture is striking. The larger vessels of the choroidal stroma pass sinuously across the fundus, causing the intervening pigmented connective tissue cells of the choroid proper to be very marked. Vision may not be much if any disturbed, as the resulting atrophy is superficial.

In myopia, or in the transitional stages between hyperopia and myopia, glaucoma, and pigmentary degeneration of the retina, this condition may be seen.

**DEEP CHOROIDITIS.—I. Diffuse Exudative Choroiditis.—**In this form the ophthalmoscopic picture shows yellowish-



white or white areas, which may have intervening patches of normal choroid, but as is most frequently seen the spots coalesce, showing a large area of sclera. Irregular spots of pigment are distributed over these areas. These pigment spots are beneath the retinal vessels as a rule, although through implication of the retina (choroido-retinitis), some pigment may be found on the retinal vessels. In some places, when the atrophy has not been sufficient to expose the sclera, the appearance given under superficial choroiditis will be seen. A yellowish exudate is sometimes seen in places, and is an early stage of what later becomes an atropic area, surrounded and partially covered with pigment. These cases may show all the stages at one time.

2 *Disseminated Choroiditis*.—This is a circumscribed form of the disease just described. The morbid process usually commences at the periphery and gradually encroaches on the fundus towards the center. The disease is characterized by roundish spots, white in the center through exposure of the sclera and surrounded by black margins consisting of changed pigment. At times there will be a black mass surrounded by a yellowish zone.

A common appearance is as though the tissues overlying the sclera had been removed with a punch, the borders of these spots being surrounded by a more or less black ring of pigment. These spots vary in number, there may be only one or two, or they may be scattered over the entire fundus of the eye. The intervening choroid may be comparatively healthy. The characteristics of this form in the early stages are similar to the diffuse type, viz., yellowish exudations, which through absorption produce the characteristic appearance. The position of the retinal vessels is also similar to that already described.

Opacities in the vitreous are not uncommon, these may be very fine and floating, or quite large. During the later stages of the disease, the optic nerve is almost always affected, an atrophy (choroiditic atrophy) ensuing. There is a slight

haziness of the edges of the optic disk, a reddish-yellow color, and the retinal vessels are contracted.

*Causes.*—Acquired syphilis seems to be the most general cause in both forms of deep choroiditis, making its appearance usually is from six months to two years after the initial lesion. Occasionally it appears during the so-called tertiary period. Although vitreous opacities are most frequently seen in syphilitic subjects, it is unwise to base a diagnosis of syphilis on either the opacities or choroidal disease alone. Other evidences of specific infection should be looked for before a positive opinion is given as to the cause.

“Disseminated choroiditis, choroido-retinitis and secondary pigment degeneration of the retina are sometimes seen in children, the subjects of hereditary syphilis.” (DeSchweinitz.) In acquired syphilis, choroiditis affects both eyes, as a rule.

“A disseminated choroiditis (hereditary choroiditis), affecting both eyes, is occasionally encountered as a family disease, independently of syphilis, and associated with the disorders of the center nervous system.” (Hutchinson.)

Choroiditis, the result of traumatism, often cannot be distinguished from the forms already described. Choroidal patches are also found in children with congenital cataract. Other causes have been given for this disease, as chlorosis, anemia, scrofula, malnutrition, and not infrequently no cause can be assigned.

*Prognosis.*—Always guarded, the most favorable results are when the case is seen early and is the result of syphilis.

*Treatment.*—A positive understanding, if possible, of the cause of the disease is of the utmost importance, as in this way only can the disease be held in check, as a rule. If atrophic changes have taken place, it must not be expected that the tissue destroyed will be replaced, but all measures should be directed to prevent further changes, if possible. In syphilitic cases during the secondary stages, the use of iodide of potassium in full doses, either alone or combined



with red iodide of mercury or corrosive chloride of mercury, will be found beneficial. Jaborandi, especially with vitreous opacities, is a valuable remedy; this drug will also be found useful in non-syphilitic cases as well. Bryonia will promote absorption of vitreous opacities, especially when they are small; if motion of the eyeball produces unpleasant sensations this drug is doubly indicated. Gelsemium in the hazy

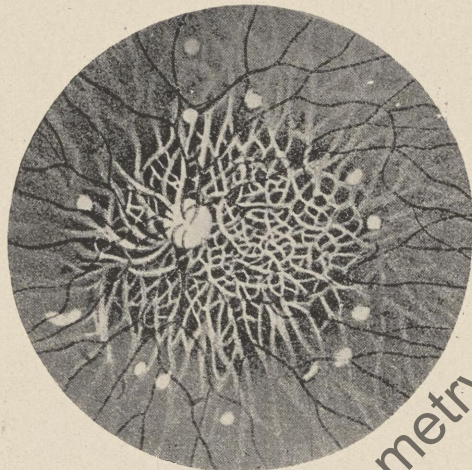


FIG. 54.—Disseminated Choroiditis, Sclerosis of the Choroidal Vessels, and Secondary Pigmentation of the Retina.—*Modified from Haab.*

condition of the vitreous, especially when there is a tendency to iritic complications; there is also a restless condition usually present when this drug is required. If disturbance of the alimentary canal is complicating the case, *nux vomica* will prove valuable, as the improvement to the nutritive powers will have a beneficial influence on the eyes. *Hydrastis*, with this same condition, will prove useful. In persons with an apprehensive condition, *pulsatilla* should always be given. In anemic persons iodide of arsenic is indicated. In scrofulous individuals some form of lime will always be required.

The eyes should be protected from bright light and close use of the eyes interdicted, rest being an important factor.

**CENTRAL CHOROIDITIS.**—This term is used when the disease is limited to the macular region. An irregular area of exudation, partially or completely atrophic, with a pigment boundary, may be seen ophthalmoscopically. A subjective symptom of this condition will be scotoma in the visual field marking the location of the lesion. A form called *senile areolar atrophy* of the choroid, in which the macula is occupied or surrounded by a considerable white area, with the rest of the fundus normal, may be found. This area may be circular, the deep vessels being exposed or atrophied when they appear as white lines (*sclerosis of the choroidal vessels*).

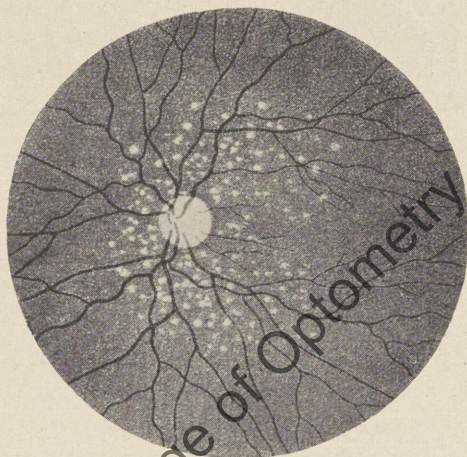


FIG. 55.—Senile Guttate Choroiditis, Colloid Degeneration.  
*Modified from Haab.*

A form of choroiditis, bearing some resemblance to the earlier stages of albuminuric retinitis, is sometimes seen and is called *senile guttate choroiditis*. This condition shows numerous white spots and nearly always is symmetrical, although a considerable time may elapse before the second



eye is affected. The white spots are the result of colloid degeneration and calcareous formations, and there is also secondary implication of the retina. There is nearly always contraction of the visual field as well as negative scotoma. Considerable areas of colloid changes however may occur without visual disturbances.

Before advising an operation for cataract, the presence of central choroiditis should be determined if possible. In the later stages of cataract, after an ophthalmoscopic examination has become impossible, this cannot be determined accurately, but may be suspected in those cases having imperfect central light perception.

*Causes.*—Inflammatory central choroiditis may result from syphilis or from blows upon the eye. In myopia, especially of high degree, chronic atrophic choroiditis has been found. Insufficiency of the internal recti muscles has also been assumed to be a causative factor. Senile changes will account for senile, central, and guttate choroiditis.

*Prognosis.*—Especially bad.

*Treatment.*—In these forms the treatment before given will be the best, but usually the eye goes from bad to worse. If refractive errors are supposed to be a cause, the best possible correction should be given and as complete rest of the eyes as possible enforced.

ANOMALOUS FORMS OF CHOROIDITIS.—There are some forms which seem impossible to classify. Considerable atrophic areas, not located in any special portion of the choroid, may be seen, and may result from absorption of hemorrhages or tubercular patches. Hemorrhagic choroiditis, especially in young men, which results in numerous atrophic spots, not easily distinguished from the syphilitic type, are not infrequent. Intense light or heat has been assigned as a cause when yellowish or other choroidal patches appear. Yellowish or maroon-colored spots, with some pigment granules in the fovea and macular region, may sometimes be seen, but the vision remains unaffected. Refractive errors

are supposed to cause this condition by some, while at times the appearance of the morbid condition appears to be associated with a temporary albuminuria, spots of degeneration resulting.

MYOPIC CHOROIDITIS.—In myopia of high degree, or in progressive myopia, there is often seen an atrophic condition of the choroid surrounding or even including the optic disk. This is a result of an elongation of the eye at the posterior pole, and is called *posterior staphyloma*. Another term often used is *sclerotico-choroditis posterior*, the same as in circumscribed inflammatory action of the anterior portion of the choroid, implicating the sclera, a forward bulging may occur, and the term *anterior sclerotico-choroiditis* is used.

Atrophic or partial atrophic crescents are sometimes seen at the temporal margin of the disk in astigmatism, and in eyes which are used excessively for close work, with improper refractive conditions. In myopia, choroidal patches may also be found in the macular region, which do not vary in appearance from those already described. These will materially impair vision. The morbid process appears as small rents which, becoming confluent, gradually form an area of atrophic tissue. In progressive myopia a hemorrhage may invade this region, and the process of absorption involving the overlying retina diminish visual acuity. The choroidal vessels are exposed as in the superficial form.

SUPPURATIVE OR PURULENT CHOROIDITIS AND IRIDOCOROIDITIS.—These conditions may be the result of traumatism, either operative or accidental, especially if septic material has been introduced. Perforating or sloughing ulcers may also be exciting causes. In either of these conditions it is confined to the affected eye.

Purulent choroiditis may result from pyemia, most frequently postpartum, or may be surgical. Septic endocarditis has produced this condition but in a less acute form. Following variola, diphtheria, scorbutus, measles, scarlet fever, influenza, cerebro-spinal meningitis, either sporadic



or epidemic erysipelas, typhoid and pneumonia, cases of suppurative choroiditis have been seen. A mild or sub-acute form is found in children under two years of age, following cerebro-spinal disturbance. In rare cases there seems to be a connection between this disease and seemingly unimportant conditions elsewhere, as the extraction of a tooth, or suppuration at a finger joint, etc. In very exceptional cases the morbid process may be confined mostly between the choroid and retina, implicating the vitreous more or less. As a rule it attacks the most or all of the tissues of the eyeball.

*Symptoms.*—Often the first symptom is intense headache followed by vomiting, elevated temperature and marked ferbrile symptoms. The lids become edematous, conjunctiva chemotic, a hazy and yellowish appearance of the cornea, aqueous turbid, iris inflamed and adherent to the anterior capsule of the lens, and often hypopyon. If the media are not too much clouded, a purulent mass may be distinguished in the vitreous, and there will be a yellowish reflection by transmitted light. The eyeball may be more or less prominent and its motion limited; when this condition exists, the surrounding tissues are usually involved. Superciliary pain is intense, the globe tender to touch on account of ciliary inflammation, vision much diminished or entirely lost. The tension in the first stages is increased, and there is a shallow anterior chamber. The outcome depends on whether the disease confines itself to the choroid and retina, or implicates all the other tissues. If it does not involve all the tissues, the severe symptoms subside, tension diminishes and the eyeball eventually shrinks.

When the inflammatory action is general however, the symptoms will be exaggerated and either rupture of the sclera or sloughing of the cornea result, which will allow the accumulated morbid material to escape. When this occurs the pain subsides, the tissues of the ball finally soften, shrink, and there is absence of pain in the sightless organ.

Phthisis bulbi, is the term applied to the latter condition and panophthalmitis designates the previous stage.

*Causes.*—Besides the causes already given, thrombosis of the orbital veins is at times a factor.

*Prognosis.*—Always bad, as total blindness is almost sure to result, as well as a shrunken globe. In a very few cases the result has been better, but these are rare exceptions. In traumatic cases there is seldom a fatal termination so far as life is concerned, and sympathetic ophthalmitis does not occur, as a rule, unless there is a foreign body in the globe, which may act as an exciting cause.

*Treatment.*—In the early stages with fever, unless traumatic, aconite; if traumatic, veratrum viride. Sulphide of calcium should be given or aqua calcis in these cases. Apis, with a stinging pain and edema of the conjunctiva and lids. Apocynum also will be indicated with these conditions, and may be given either alone or in combination with the apis. During the early stages the use of atropine solution may afford relief. Cold applications, especially if a traumatic case, may also be useful, but after the early stages heat may afford the most relief. Paracentesis, or even a free incision into the globe through the sclera, well into the vitreous, may be required. The advisability of either an enucleation or evisceration during the inflammatory stages is a question, as there is danger of cerebral complication, no matter how carefully the operation is conducted. After the inflammation has subsided, especially if a foreign body is suspected to be the exciting cause, an enucleation is advisable.

The practice of blood-letting or blisters in these cases seems reprehensible, as the patient already has enough to contend with without further lowering the power of resistance.

**TUMORS OF THE CHOROID.**—Sarcoma is the most frequently seen, usually as a pigmented tumor (melano-sarcoma), the non-pigmented (leuco-sarcoma) being much more rare. Sarcoma is most frequently seen between the ages of thirty-five and fifty-five, seldom under twenty years of age.



More frequently seen in men than in women, and the growth appears to have an affinity for the left eye. The disease is a primary affection, except in a few rare instances, and attacks but one eye. The base of the tumor is broad, located in the choroid, and may occupy any portion of the fundus. The form assumed is usually roundish; at least, before rupture of the choroid occurs. The growth, as a rule, is circumscribed and the starting point is in the larger choroidal vessels; if extension occurs it is through the vascular channel. The most of the free surface is covered by the vitreous lamina and uveal pigment.

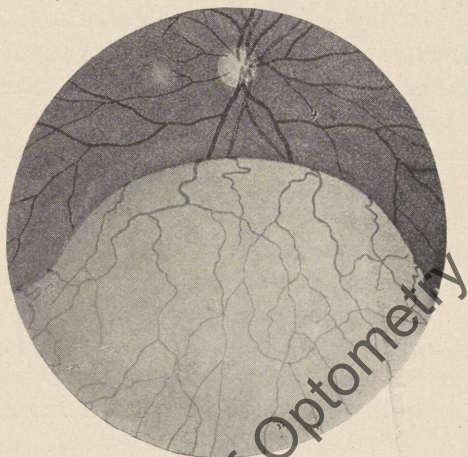


FIG. 56.—Sarcoma of the Choroid.—*Modified from Haab.*

In some cases the chorio-capillaris cannot be distinguished. The neck of the tumor may correspond to the point of rupture of the vitreous lamina. Extravasations of blood are often present, as the blood-vessel walls are quite thin. Pigmentation is usually greatest near the sclera, but may be variable in different portions of the mass. Spindle cells, as a rule, compose the tumor, but they may be round; in some instances both forms are found.

*Causes.*—No positive cause is known for this disease.

*Stages.*—Usually divided into four. The first stage is free from inflammatory action; the tension may be normal or sub-normal, the media clear, and if the growth is peripheral there may be no marked impairment of central vision. As the ophthalmoscopic examination reveals an appearance similar to that shown in detachment of the retina, the diagnosis can only be determined by careful observation. The retina is pushed forward by the tumor and serous effusion obscures the entire area. Sometimes by careful examination the brownish mass may be discovered through the retina, and the choroidal vessels can possibly be seen, unless the morbid condition is of the non-pigmented variety. It is possible at times, when the growth is well forward, to observe it by oblique illumination, having the pupil well dilated. There is always a defect in the field of vision corresponding to the location of the tumor. Diminution of vision will depend on the location. This stage lasts from six months to a year, although some instances of a longer period are given.

In the second, inflammatory or glaucomatous stage, there is increased tension, pain in the superciliary region, corneal anesthesia, shallow anterior chamber and opacity of the media, making an ophthalmoscopic examination impossible. The lens may become cataractous. Irido-cyclitis may result, in which case there may be sympathetic irritation of the other eye.

The third stage follows the increased growth, in which the tunics of the eyeball are ruptured, and if the scleral rupture is not too far back there will be seen a dark mass external to the eyeball. When rupture occurs there will be at once a diminution of tension. The surrounding tissues become involved and the fungous or episcleral stage follows. The morbid process may extend to the brain, or secondarily involve the optic nerve. Usually the fourth or metastatic stage results, in which distant organs are affected by similar growths, the liver most frequently, the lungs, spleen or in-



testines may also be diseased. Metastasis may occur before the rupture of the sclera.

*Diagnosis.*—Not always easy. The age of the patient will aid in differentiating from retinal glioma. Idiopathic detachment of the retina, has been mistaken for sarcoma of the choroid, especially during the earlier stages of the disease. The history in retinal detachment, is usually of a sudden attack and the ophthalmoscope may reveal the true condition, but sometimes a positive diagnosis is extremely difficult. The tension of the ball is not always changed in the first stage, so too much reliance cannot be placed on this sign. During the second stage, increased tension will be found, and sometimes sarcoma can be distinguished from glaucoma, by the previous failure of vision and the steadiness of the pain, while in glaucoma the onset is often sudden, vision good up to the time of attack, and frequently periods of comparative freedom from pain during the acute attack, and the tension can usually be diminished by myotics, but a positive diagnosis cannot always be made between the two diseases.

*Prognosis.*—Always bad. Death is pretty sure to result, usually within five years of the commencement of the growth unless early recognized and an operation is performed. If there is no recurrence within four years the patient is comparatively safe. In the later stages recurrence is probable as well as metastasis.

*Treatment.*—Enucleation during the early stages if possible. The orbit may have to be cleared of tissues besides the removal of the ball. Careful examination of the orbital tissues should always be made in these cases, before leaving the patient.

Enchondroma, cavernous angioma, angio-sarcoma, telangiectatic sarcoma, and adenoma have all been described as occurring in the choroid, but are seldom seen.

CARCINOMA OF THE CHOROID.—This disease has been seen, but probably always as a metastasis of carcinoma in

other regions. The growth is rapid and seems to elect the macular region, appearing as a flat growth. Operations in these cases are usually not advisable.

**TUBERCLE OF THE CHOROID.**—This disease shows as small, yellowish-white spots, 1-24 in. to 1-16 in. in size, but may vary from this. Careful examination only, will show this condition, and it may be entirely overlooked. Tubercular growths may also be present in the meninges when the tubercular spots show in the choroid.

Miliary tubercles, so-called, are growths usually near the optic disk or macular region, and are multiple. The spots are a pale reddish color, which rapidly increase in size and number. This rapid growth differentiates them from inflammatory action in the choroid, which is of slow development. According to Cohnheim, miliary tubercle of the choroid is one symptom of general miliary tuberculosis. This may prove a valuable diagnostic sign in obscure cases. However, this condition is not generally seen in chronic tuberculosis of the lungs, intestines, etc.

A single large tubercle of the choroid is sometimes seen. The ophthalmoscope shows a rather large light colored tumor. The diagnosis is made more certain if small tubercular spots are in close proximity to the larger growth. Fortunately this is a rare form of disease, and is seen most frequently in young people. The disease is essentially chronic and is generally associated with tuberculosis of the brain. The ultimate result of the tumor in the eye is very similar to that of sarcoma; the tumor may grow through the sclera and eventually break down.

*Prognosis.*—Always serious, as not only the eye is lost, but life itself is threatened by the presence of tuberculous disease in other organs.

*Treatment.*—In the miliary type, treatment should be directed to constitutional measures, as local methods are useless in the solitary form, when no other tubercular symp-



toms are manifest, an enucleation is advisable, provided the patients general condition will justify this measure.

INJURIES OF THE CHOROID.—See injuries of the sclera.

RUPTURE OF THE CHOROID.—This results from a blow, most generally upon the eye. The lesion is most frequently seen on the temporal side of the disk, very seldom on the nasal side, and not often extending horizontally. The shape of the rupture is crescentic, the concavity being towards the disk and the broadest portion at the center of the lesion. When the retinal vessels extend over the rupture,

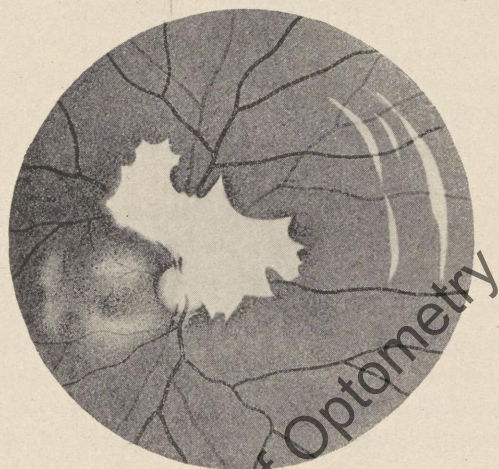


FIG. 57.—Multiple Ruptures of the Choroid. The central white fibrous patch partially covering the disk, is the result of the hemorrhage which followed the blow.—*Modified from Haab.*

which is the rule, it shows the retina is uninjured. Extending along the edges of the rupture are irregular black lines due to pigment growth. The color of the streaks are yellowish-white, the color being due to the sclera showing through the lesion. The rupture may be single or multiple. Immediately following an injury severe enough to cause

rupture of the choroid, the amount of damage done can seldom be determined, as there will be extravasation of blood into the vitreous, making a satisfactory examination impossible. Only after the blood has been absorbed can a positive diagnosis be made. When the retina has also been injured, the hemorrhage is more serious, and after absorption has taken place no retinal vessels are seen crossing the lesion.

*Prognosis.*—Depends upon the extent and location of the rupture. Vision immediately following the injury is much impaired, sometimes only perception of light remaining, especially if the iris is injured, when there will also be effusion of blood into the anterior chamber. After absorption has occurred, good vision may result, unless damage to the choroid has been too great. Secondary changes may result in these cases, from the optic nerve becoming implicated.

*Treatment.*—Locally the instillation of a mydriatic, usually atropine. Rest in the recumbent position should be insisted upon. Iced cloths may also aid in keeping down inflammatory action.

Internally veratrum viride is the most generally indicated remedy as traumatic febrile symptoms are usually present. Jaborandi will hasten absorption of blood, giving it in doses of gtt. ss to j every two hours. Bryonia is indicated by aggravation of discomfort on motion of the eyeball. Gelsemium in doses of gtt. 1-3 to ss every one or two hours will often be indicated in these cases, and seems to also have an influence on the absorption of the hemorrhage.

**HEMORRHAGE INTO THE CHOROID.**—This condition may result from traumatism, and may be diagnosed from retinal hemorrhages by the diffuse character of the effusion, and also by the retinal vessels passing over the spot. The diagnosis however is not easy.

*Treatment.*—Treatment just described will be sufficient.



DETACHMENT OF THE CHOROID.—This may be idiopathic or traumatic, but is seldom seen. The detachment may be partial or complete. It sometimes follows cataract extraction. It may also result from effusion of blood, serum, lymph, or a tumor.

OSSIFICATION OF THE CHOROID.—This condition is sometimes found in eyeballs shrunk from irido-choroiditis. The bony formation is found in the inflammatory tissue. Palpation will reveal this change, the sensation to the finger being that of a solid body covered with a layer of soft leather. Calcareous degeneration is not uncommon in these eyes.

*Treatment.*—Enucleation.

ATROPHY OF THE EYEBALL.—This results from the contraction of inflammatory exudates in the globe. The eyeball may be diminished in size, or may be irregular in form. It is distinguished from phthisis bulbi by Fuchs, by not being the result of suppurative inflammation with rupture of the sclera.

HYPOTONIA.—A term given where there is diminished intra-ocular tension. It always indicates a diminution in the volume of the anterior structures of the globe. This may result from many causes. After the application of a tight bandage over the eye a temporary softening of the eyeball may be noticed. Shrinking of the exudates following irido-cyclitis will cause the globe to be very soft. Detachment of the retina is often followed by decrease of tension. Paralysis of the sympathetic may produce this condition, and not infrequently the instillation of cocaine will be followed by temporary softening.

ESSENTIAL PHTHISIS, or ophthalmomalacia, is a condition which comes on suddenly without any apparent cause. There is sudden softening of the ball, diminution in size, and redness. Neuralgic pain and photophobia are frequently

present. The condition may last from a few hours to several days when there is a return to normal. Occasionally these attacks are intermittent. This is a disease seldom seen and the cause in most instances is unknown. It sometimes follows an injury.

*Prognosis.*—Usually good as the disease disappears spontaneously.



## CHAPTER X.

### GLAUCOMA.

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Glaucoma is a serious disease of the eye, in which increased intra-ocular tension is one of the most important symptoms. The disease may be *primary*, that is, without apparent previous eye disease, or *secondary*, the result of morbid conditions existing prior to the glaucomatous attack.

The cause of the increased tension is undoubtedly due to obstruction of the passage of the fluid secreted by a portion of the ciliary body, which is required for the nutrition of the vitreous and lens, as well as for maintaining the normal quantity of fluid in the aqueous chamber. In some manner the filtration angle, which normally allows the escape of the fluid, becomes impervious, and an increase of tension results as secretion still continues.

SYMPTOMS.—A general line of symptoms are common to all forms of glaucoma, with the exception of the chronic type, in which many of the most prominent features are lacking, although some of them may be absent in individual cases.

1. *Increased Tension or Hardness of the Globe.*—This varies from Tn. tension normal to T+3. If there is a question about the increase of hardness the ? is employed, but when the globe shows marked resistance on palpation, T+1, T+2 or T+3 are used to designate the degree. The latter represents very hard, the impression under the finger being similar to that of a marble. The educated finger-tips soon estimate the resistance closely enough for all practical purposes.

2. *Variation in Shape and Size of the Pupil and the Mobility of the Iris.*—The pupil may be partially or fully dilated, oval or round. These conditions are sometimes absent in simple glaucoma. The iris is slow in movement or inert. There is often a greenish reflex from the lens seen in the pupil.

3. *Diminished Transparency of the Cornea.*—In some cases the cornea presents a dull appearance, somewhat similar to glass which has been breathed upon. This haziness is most marked in the congestive types, while in the simple form it is slight or lacking. The haziness is most marked at the center of the cornea. Schweigger states that a similar appearance may result from iritis and irido-choroiditis. Edema of the cornea is the cause of the cloudiness.

4. *Alteration of Depth of the Anterior Chamber.*—This varies from a scarcely appreciable shallowing to complete obliteration. This change is due to the pushing forward of the lens and periphery of the iris. In secondary glaucoma, resulting from a serous cyclitis, the lens is pushed backwards and the anterior chamber correspondingly increased in depth.

5. *Morbid Changes in the Iris, Aqueous and Vitreous.*—In the congestive type, especially, the characteristic markings of the iris may be lost; this usually results from edema affecting the cornea. The veins are often dilated and tortuous. The aqueous and vitreous often contain opacities, and cataract may form.

6. *Changes in the Conjunctival and Episcleral Vessels.*—In the acute type there is not only a general hyperemia with marked ciliary congestion, but often edema of the conjunctiva. In chronic inflammatory and simple glaucoma, the episcleral venous branches are enlarged and tortuous.

7. *Cupping of the Optic Disk and Choroidal Changes.*—The increase of intra-ocular tension will cause a bulging at the point of least resistance, which is at the point of entrance of the optic nerve, and this giving way produces the condition called glaucomatous cupping of the optic disk. Knies



thinks edema of the nerve head appears before the cupping, and some writers claim that neuritis precedes an increase of tension.

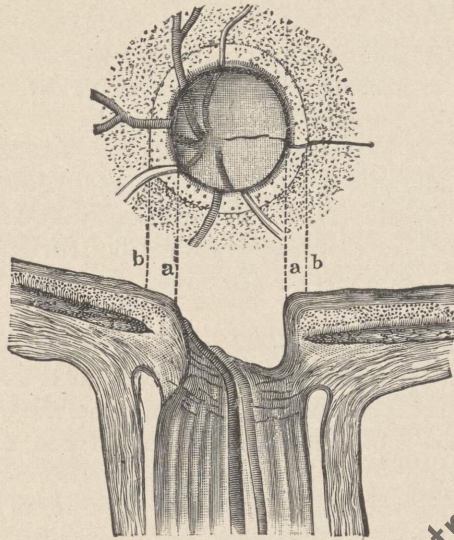


FIG. 58.—Glaucomatous Cupping.—*Fox and Gould.*

The cupping varies through all the stages from a commencing excavation to the complete cup. In the last stage the excavation extends to the scleral margin and the edges are abrupt. The vessels are displaced to the nasal side of

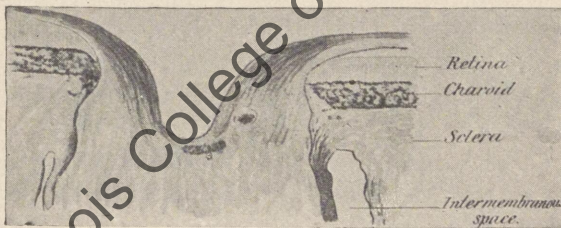


FIG. 59.—Physiological Cupping. The excavation is about one-third as broad as the optic nerve. Just below the excavation are seen cross-sections of two blood-vessels.—*Fick.*

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the disk, and bending sharply over the edge disappear behind the border, appearing again at the bottom. Surrounding the papilla is a yellowish ring, the result of choroidal atrophy. At times it is difficult to distinguish between an atrophic and glaucomatous cupping, especially if the latter is shallow, or glaucomatous and physiological if the latter co-exists with primary optic nerve atrophy.

As a rule, in physiological cupping the excavation has not the abrupt margins and is not partial, and the normal tint of the disk is present. In atrophic cupping it is complete, shallow, and with an abnormally white disk. In glaucoma, besides the appearances already stated, there may be a greenish tint.

8. *Pulsation of the Blood-Vessels.*—There may be venous pulsation at the margin of the disk, but this is not pathognomonic, as this condition is often seen in normal eyes. Arterial pulsation is of more diagnostic importance, as it is rarely seen in healthy eyes. It is usually perceptible near the disk, and often can be produced by slight pressure on the eyeball. Small aneurisms of the arteries, and a varicose condition of the veins, are sometimes seen.

9. *Pain.*—This varies considerably. In acute attacks there is severe neuralgic pain along the trigeminal nerve, and in the congestive type extreme depression, nausea and vomiting are often present.

In the subacute type, the pain is confined to the same region, but the pain is less severe. In the chronic form there may be simply a sensation of discomfort, fullness, or, as the patient says, a headache. Neuralgic pains are transient and infrequent.

10. *Corneal Anesthesia.*—This will be found during acute attacks, or after the disease has progressed to the degenerative stage. The anesthetic condition varies from very slight to nearly as complete as cocaine anesthesia. The lack of sensibility may be circumscribed or cover the entire cornea, and undoubtedly is the result of edema of the corneal tissues.



11. *Changes in Visual Acuity.*—Central visual acuity may be good for some time in the chronic type. In subacute glaucoma there is a rapid failure of vision, which improves as the attack subsides. In the acute form the loss of vision is sudden, often only perception of light remaining in a few hours after the commencement of the attack. A malignant type may quickly produce total blindness.

12. *Changes of Refraction and Accommodation.*—The changes produced in the curvature of the cornea through intra-ocular pressure, and the change in the position of the lens, will change the refractive condition, and in chronic glaucoma astigmatism will often change from the rule to against the rule. The pressure exerted upon the ciliary nerves will diminish the accommodative power, and the patient will wish to change reading glasses frequently, and select those entirely too strong for the refractive condition.

13. *Contraction of the Field of Vision.*—Peripheral vision is always diminished, and in all cases a carefully drawn chart should be preserved. The changes are: (a) Partial or complete absence of the nasal field. This is the typical condition; (b) contraction of entire field; (c) contraction, leaving an oval field; (d) a sectional defect, generally in the upper portion; (e) entire field destroyed, except a small area on the temporal side. The color fields, as a rule, contract proportionally with that of form. This contraction continues, if the disease is unchecked, until blindness results.

14. *Iridescent Vision.*—In looking at an artificial light, it is often surrounded by a ring of more or less distinct prismatic colors, the red being on the outside. This condition is probably the result of changes in the corneal epithelium through increased pressure.

Subjective light perceptions are sometimes noted by persons totally blind from glaucoma. One patient under observation, who was totally blind, said that at times the furniture in the room could apparently be distinctly seen.

ACUTE PRIMARY GLAUCOMA (Congestive or Inflammatory Glaucoma).—Unfortunately, this disease is often mistaken for conjunctivitis, iritis, a neuralgic condition, or erysipelas, and loss of vision results from the error. The acute attack may or may not be preceded by premonitory symptoms. When such symptoms do occur there will be a disposition to change reading glasses frequently, and there will be temporary dimness of vision which may be very marked, lasting for a number of minutes at a time, as well as the colored circles around an artificial light. There may be pain around the orbit, the pupil slightly dilated and a faint turbidity of the cornea and aqueous. The ophthalmoscope reveals nothing characteristic at this time.

These symptoms may disappear and the eye resume nearly its normal condition, but repeated relapses finally bring on a true glaucoma.

The time usually selected for an acute attack is the latter part of the night. Sudden severe pain in the eye, which extends to the forehead and temple of the same side, or it may include the entire side of the face and head. There may be extreme general depression, with pallid face and cold extremities, or the face may be flushed and considerable fever. Nausea and vomiting often supervene. Vision is very much reduced. The eyelids become swollen and the conjunctiva injected and chemotic, cornea dull and anesthetic, pupil motionless and partially dilated, aqueous clouded and discoloration of the iris.

If the attack is very severe, there may be perceptible protrusion of the eyeball. Lachrymation is excessive, and although the eye may be nearly blind, light seems to increase the suffering of the patient. The anterior chamber is shallow, and the tension rapidly increases. During an attack an ophthalmoscopic examination can seldom be made on account of the hazy condition of the cornea. If the case is neglected some of the symptoms gradually subside, but the mobility of the iris is lessened, vision more or less impaired, and a



slight increase of tension remains. Usually both eyes are affected, possibly within a few hours of each other, but months may elapse before the second eye is attacked. If measures for relief are not taken, or prove futile, a glaucomatous state results, the pupil is dilated and immobile, iris discolored, lens shows the greenish reflex, anterior chamber shallow, cornea hazy, and if a view can be obtained, vitreous opacities can be seen, and sometimes hemorrhage into the retina and choroid are visible.

The stage of absolute glaucoma soon follows, vision being destroyed, cataract developing and a pushing forward of the lens, atrophy of the iris, obliteration of the anterior chamber, discolored sclera, cornea clouded or even ulcerated, and the episcleral vessels markedly injected. Eventually all the structures of the eyeball become disorganized, the sclera becoming thinned and bulging, producing staphyloma, or may even rupture. If the latter occurs, there is severe hemorrhage with final collapse of the eyeball. However if the ciliary body becomes disorganized before the thinning of the sclera occurs, there will be diminished tension and shrinking of the ball. A shrunken eyeball may not be free from attacks of pain. Acute glaucoma may in some cases assume a chronic type.

GLAUCOMA FULMINANS is a term used to designate a type of acute glaucoma which fortunately is seldom seen. Initial symptoms are lacking and the disease fully develops in a few hours, vision being permanently destroyed and absolute glaucoma results without any periods of relief.

SUB-ACUTE PRIMARY GLAUCOMA.—This is an intermittent type. At first there may be only temporary symptoms as in the acute form, but the attacks become more severe and frequent, the periods of quiescence less complete until a true congestive glaucoma exists. Tension is permanently increased, the field of vision contracts, and cupping of the optic disk commences. As the disease continues, there are returns

of the pain and ciliary congestion until complete blindness results, but this is not as rapid as in the acute form.

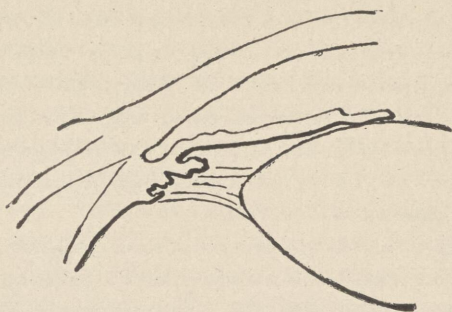


FIG. 60.—Angle of Anterior Chamber in the normal eye.

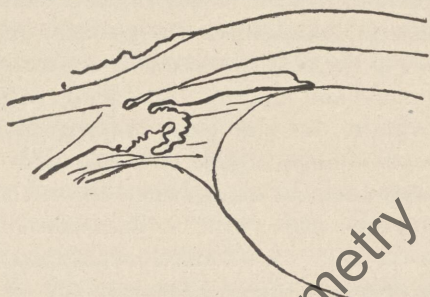


FIG. 61.—Angle of Anterior Chamber in Glaucoma, closed by adhesion of iris-base to the periphery of the cornea.

**CHRONIC PRIMARY GLAUCOMA.**—This form of glaucoma is insidious in its course, the attacks of pain, ciliary injection, etc., being absent. This condition may last for years, and total blindness of one eye be established before the patient is aware of any serious trouble. Both eyes are seldom affected at the same time. The patient complains mostly of failing vision. This type seldom comes on under the age of fifty. In some cases there will be temporary dimness of vision, as well as colored circles around an artificial light, but this is not the rule.

The external appearance of the eye in glaucoma may show but slight changes, the ciliary vessels may be a little enlarged



and the anterior chamber shallow, although this may be no more than is often seen in healthy eyes of the same age. The pupil may or may not be enlarged and sluggish. Even in an eye blind from this disease, the pupil may not be dilated and may be consensually active. The lens may present the appearance of a mature cataract and yet the fundus be clearly defined by an ophthalmoscopic examination. This error in diagnosis has led to operative measures in some instances. The tension is increased; in the earlier stages it is slight, but later the increased tension will be very marked. The optic disk presents the characteristic cupping with displacement of the vessels to the nasal side. The accommodative power is much reduced, acuteness of vision impaired, visual field probably typically contracted, and the refractive condition hyperopic, as a rule. In some cases it is difficult to differentiate between glaucoma and simple optic atrophy. In atrophy the cup is shallower, color vision much more reduced, and the blind area in relation to the optic disk less regularly distributed. The colored circles of light are valuable in diagnosing glaucoma when possible to test such a history.

**ABSOLUTE GLAUCOMA.**—As already stated, this is the stage of total blindness, and the term is always applied when this condition is reached, no matter what the original form of the disease.

**SECONDARY GLAUCOMA.**—This is the result of some pre-existing disease and is always a serious complication. It may assume either an acute or chronic form. It sometimes follows iritis or cyclitis; perforating corneal ulcers with anterior synechia or staphyloma; swelling of the lens, the result of injury, operative or accidental; severe hemorrhage following retinal detachment; dislocation of the lens, and intra-ocular tumors.

The diagnosis of secondary glaucoma is usually not difficult, unless the exciting cause is in the deeper structures of the eye.

**HEMORRHAGIC GLAUCOMA.**—This disease resembles in some respects the primary forms, and frequently cannot be distinguished from them. It may be acute, subacute or chronic. Retinal hemorrhages occur as the result of degeneration of the walls of the retinal vessels, or through any condition which may cause extravasation of blood. There is increased tension, and the character of the symptoms will not vary materially from those already described, depending upon the type assumed. The ophthalmoscopic examination will reveal the retinal hemorrhages as well as the usual glaucomatous appearance, unless hemorrhage into the vitreous occurs, when a view of the fundus will be impossible. In this condition the eyeball is generally much injected. It is not always possible to decide whether the hemorrhages are simply associated with the glaucoma or are primary.

**COMPLICATED GLAUCOMA.**—A division sometimes made of secondary glaucoma, where there is cataract, or a high degree of myopia with glaucoma. In the cataractous condition it does not refer to those cases where total blindness and cataract are the results of degenerative changes in a glaucomatous eye.

In the myopic form, not only the usual changes occur, but also some choroidal patches will be seen, and this may be the exciting factor of the glaucoma.

*Causes.*—Primary glaucoma is seldom seen under the age of forty. Small eyes, with an excessively large lens, seem to be more often affected than when the proportions are normal. Where there is a predisposition to glaucoma, it usually depends upon structural conditions which interfere with the normal relations of the eyes. Disturbances of the circulation in such eyes may produce congestion of the uveal tract, and may be an exciting cause. This congestion may be produced by exposure to cold and damp, severe mental depression, exhaustion, constipation, diseases of the circulatory or respiratory systems, gout, syphilis; in fact, anything that



disturbs the circulation and produces congestion of the venous system. Injuries of the eye or head, or slight injuries of the cornea may be exciting causes.

The instillation of mydriatics may excite glaucoma in an eye so predisposed or where the incipient stages are present. The administration of belladonna or atropine, until the physiological effects of the drug are obtained, may produce an effect similar to the instillation of a mydriatic. Women are more susceptible to the disease than men. Heredity is undoubtedly a factor. Ametropia has also been assigned as a cause, especially hyperopia.

CAUSES OF SECONDARY GLAUCOMA.—Exclusion of the pupil through an iritis, preventing the circulation of the aqueous between the posterior and anterior chambers, will push the iris forward, obstructing the filtration angle, and will excite an attack of glaucoma. In such cases detachment of the retina usually occurs. The ciliary processes finally atrophy and shrinking of the ball results. Total posterior synechia may also cause glaucoma.

SEROUS CYCLITIS.—In these cases the secretion of the ciliary body, which enters the anterior chamber, is abnormally albuminous, and does not easily escape from the eye. The excess of fluid in the anterior chamber pushes the iris and lens backwards, punctate deposits are seen on the posterior surface of the cornea, and the filtration angle becomes clogged. Tension may be increased and the usual symptoms of glaucoma follow, excepting that the anterior chamber is deeper than normal. In very severe cyclitis the tension is frequently less than normal, as secretion is diminished or suppressed. In these cases there will be shrinking of the vitreous, degeneration of the lens, and the aqueous chamber obliterated.

CORNEAL PERFORATION WITH ANTERIOR SYNECHIA.—The conditions presented are not unlike those existing in exclusion of the pupil.

**CATARACT OPERATIONS.**—That secondary glaucoma may follow cataract operations must be remembered. The condition may occur any time after the operation, even years after good results have been obtained. No method of operating appears to be free from this result. In some manner the filtration angle becomes occluded and glaucoma results. Traumatism of the lens, either operative or accidental, may result in glaucoma.

**DISLOCATION OF THE LENS.**—In eyes in which the lens is dislocated into the anterior chamber, glaucoma may occur. Where there is lateral dislocation of the lens, the result of a blow, glaucoma is especially liable to occur, as the structures of the ball necessarily are injured in these cases.

*Prognosis.*—Unfavorable, as under any form of treatment the eye may be lost.

*Treatment.*—Early measures for relieving the increased tension must be employed if vision is to be retained. When the absolute stage is reached the only thing is to give relief from the pain, and this is best done by an enucleation. Operative measures are the most certain for preserving the usefulness of the eye. It is true that some cases can be treated successfully without resorting to an operation, but they are exceptions.

*Local Treatment.*—Eserine will often rapidly reduce tension. The action of eserine in these cases is contrary to its influence on a healthy eye. In glaucoma the drug by contracting the sphincter of the iris, thins the membrane and draws upon the peripheral portion, the tendency being to relieve obstruction of the filtration angle. The drug is useful in all cases of primary glaucoma when contraction of the pupil can be obtained. In chronic congestive glaucoma it may have a palliative action by decreasing tension, but it is usually only temporary. In secondary glaucoma, the result of hemorrhage or lateral displacement of the lens, it will at times afford relief. If paralysis of the iris spincter has occurred, eserine will fail to have any action and the



drug then should not be used, as all drugs possess a double action, and if the results are not beneficial it is very certain harm will follow their use. Eserine increases the hyperemia and also the pain in many cases where pupillary contraction does not follow its instillation. The strength should not be more than gr. j to fl. ʒj of distilled water and in many cases a solution  $\frac{1}{2}$  or  $\frac{1}{4}$  this strength will be better. The solution should be used only frequently enough to keep the pupil contracted. At first the solution will be colorless, but it soon becomes pink, and after some little time a dark red; this does not however seem to impair the activity of the drug.

*Atropine.*—This drug should never be used in glaucoma unless it is in the secondary form where the increased tension is the result of serous exudation into the aqueous chamber. In these cases the anterior chamber is deeper than normal and the action of the atropine may restore normal tension by relieving the inflammation. It is often a very difficult matter to decide whether a myotic or mydriatic is required, and in some cases a weak solution only should be used, keeping the patient under observation for one or two hours, by which time one can be fairly certain which to employ.

*Cocaine.*—The action of this drug in dilating the pupil is similar to atropine, and it has been known to produce glaucoma. In some cases however through its contracting action on the ciliary vessels, it may prove useful when combined with eserine, but it must be in such proportion as will allow the eserine to have its full effect on the pupil. The amount of cocaine used with the eserine should be about gr. v to gr. j of the myotic. Caution in the use of this drug is necessary on account of its action on the corneal epithelium.

*Sulphate of Morphine.*—Sulphate of morphine given in small doses every two or three hours will sometimes relieve an attack and lessen pain. The action of the drug is to diminish secretion, contract the pupil and lessen the blood pressure.

Jaborandi, on account of its action on the circulation, is valuable in many of these cases. It also, through its action of promoting absorption of morbid exudates and the contractile power on the pupil, is of undoubted value in these cases. In several instances administration of the drug has been followed by rapid restoration of the functions of the body, which apparently were the exciting factors in glaucomatous attacks; in one case especially, in which there was disturbance of the menstrual function, the drug acted promptly, affording complete relief.

Salicylate of sodium has been recommended and will be found beneficial in some cases where rheumatic conditions are present.

*Heat and Cold.*—Hot or cold applications will sometimes control the pain, but either application must be governed by the relief afforded the patient, as no arbitrary rule can be given.

Rest will often have a beneficial effect in these cases.

In cases suffering from obstinate constipation, the bowels should be freely evacuated and kept in good condition.

Massage of the eyeball has been recommended, and in some cases appears to have a beneficial influence.

It must be remembered in all these cases that the treatment given above is palliative, and that as a rule, even when the eye apparently recovers, there is a strong probability of a recurrence, and the above measures gradually become less effective. These measures are useful in alleviating the more severe symptoms, thus placing the eye in the most favorable condition for operative treatment.

*Operative Measures.*—The time selected for an operation will depend upon the severity of the attack. In acute glaucoma, when, under the treatment already described, there is no marked improvement within a few hours, an iridectomy should be performed. This, when promptly done, will usually restore vision nearly to its normal; the longer the delay in operating the less the chances are for comparative restora-



tion of vision. If there is perception of light, or if light perception has been lost but for a few days, the operation should still be performed, as some vision may return, and it is also the surest measure for relief from the pain.

In subacute glaucoma, an early iridectomy promises the best results.

In chronic glaucoma there is not much hope of improving the vision, but an iridectomy may save what remains, although sometimes the opposite effect is produced and aggravation of the disease results. However, as it is the only measure that will save the eye from total blindness, it is justifiable to operate, having first, of course, explained to patient and friends the serious character of the disease and the chances for and against favorable results. The chances are better during the early stages than the later.

Iridectomy in these cases is for the purpose of restoring as nearly the normal circulation within the interior of the globe as possible, thus diminishing the liability of recurrence of the disease with its certain consequences. For this reason, the incision opening the anterior chamber should be well back of the apparent corneal margin, as nearly 1-12 of an inch (2 mm.) as possible, and the incision should be extensive enough to allow of the withdrawal of sufficient iris tissue to make an iridectomy of at least 1-5 of the iris, the cutting being at the periphery of the iris. The first cut with the scissors should sever about half of the iris, then drawing it to the opposite side completely sever the balance with another cut of the scissors. In this manner the iris is excised close to the ciliary border, and there is less danger of some of the iris becoming entangled in the wound.

Caution must be exercised in making the incision, on account of the shallowness of the anterior chamber, and also that the aqueous is not allowed to escape too rapidly, as a sudden diminution of tension may be followed by intra-ocular hemorrhage. In severe cases, a scleral puncture is advocated by some, just before the iridectomy. Priestley Smith

advocates scleral puncture as an adjunct in either iridectomy or sclerotomy. This is also employed in those cases in which the tension is not sufficiently relieved after an iridectomy. It is important that none of the excised iris remains in the angle of the incision.

Following the excision of the iris, there may be considerable hemorrhage into the anterior chamber. It is better to allow this blood to be removed by absorption than endanger the lens by excessive efforts for its removal. Absorption usually is slow in these cases. The anterior chamber may not be restored within a week, and temporary slight increase of tension sometimes occurs a day or two after the operation. The preponderance of opinion is in favor of bandaging the eyes after operation, the diseased eye being kept bandaged until healing has taken place and the anterior chamber reformed. A bulging scar is sometimes formed during the healing process, most frequently when the angles of incision contain iris tissue. In those cases where a sudden marked increase of tension follows shortly after the operation and intense pain is present, intra-ocular hemorrhage is to be suspected.

In acute glaucoma the results of an operation are more favorable than in the other forms, but even in these cases it does not always check the disease.

Malignant glaucoma sometimes follows a perfect operation in chronic progressive glaucoma. Schweigger advises in chronic glaucoma, where both eyes are affected, that the worst eye be treated first, and if no complications arise, the fellow eye will usually respond favorably to the operation.

Posterior sclerotomy and sclerotomy, as well as paracentesis of the cornea, are other operations sometimes advised for relieving the tension, but an iridectomy has received the most favor excepting in rare conditions. The manner in which iridectomy effects a cure in glaucoma is not positively known, but in some manner there is restoration of circulation, probably through the filtration angle.



In secondary glaucoma due to exclusion of the pupil, an early small iridectomy will generally prove curative. In serous cyclitis, the anterior chamber deepened, lens and iris pushed backwards, paracentesis of the cornea, repeated if required, will in conjunction with treatment for cyclitis often effect a cure. In dislocation of the lens into the anterior chamber, with glaucomatous symptoms following, removal of the lens will often be curative.

Enucleation of the eye usually is the only treatment where the glaucoma is dependent upon intra-ocular tumors, and also in lateral dislocation of the lens, the result of a blow. The treatment of these cases after an operation does not vary from that followed in all major operations upon the eye. Bandaging, absolute quiet and attention to systemic measures being as necessary as after cataract operations.

## CHAPTER XI.

### DISEASES OF THE CRYSTALLINE LENS.

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The crystalline lens is developed from the ectodermic embryonic layer, and may be called a specialized epithelial structure. The surrounding capsule appears to be developed from the mesoderm. The capsule is a comparatively strong, elastic membrane, but is rather brittle, tearing easily when cut or scratched with a sharp instrument. The lines of fracture are irregular.

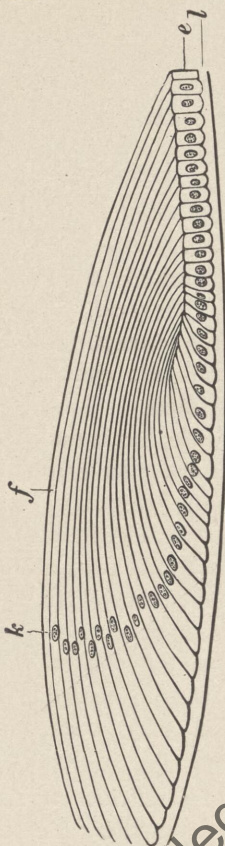
The lens is less firm than the capsule, and is sufficiently elastic to be acted upon by the muscles of accommodation, thus giving the range of vision. In early life the consistency of the lens is practically the same in all portions, but in later years the central or nuclear portion becomes more or less firm, while the surrounding substance still retains considerable elasticity. This surrounding portion is called the cortical substance. The change in consistency commences in childhood, but is not marked until later in life. On account of this change in the density of the lens there is more light reflected from the nuclear portion, and the pupil loses its intense black look. The refractive condition of the lens also changes.

Two layers of epithelium compose the structure of the lens. These layers consist of long ribbon-like fibers passing from before backwards, which on account of their arrangement give an appearance, sometimes discernible with the ophthalmoscope, called the "*lens-stars*." In the earlier stages



of development the lens is nearly spherical, the shape changing until near puberty when it usually has assumed its normal form.

FIG. 62.—Nuclear Zone of the Lens. *l*, Lens capsule. The epithelial cells, *e*, by a process of gradual elongation, grow out into the lens fibers, *f*, with the nuclei, *k*.—*Fuchs*.



The nutrition of the lens after the foetal stage, is conducted through the inter-cellular spaces, the nutrition evidently being supplied by the ciliary body.

#### CONGENITAL ANOMALIES.

—*Aphakia, an Absence of the Lens*.—In the majority of cases there is displacement of the lens, but absence of this body has been reported in microphthalmic eyes.

*A. Small Lens*.—An abnormally small lens sometimes occurs, but is observed only by an ophthalmoscopic examination when the pupil has been well dilated with a mydriatic. A dark ring, prominently outlined against the fundus reflex, marks the edge of the lens. The iris is usually tremulous and the anterior chamber deeper than normal.

*Lenticonus*.—An abnormal curvature of either surface of the lens, or a nuclear anomaly. Conicity of the lens surface is rare. The posterior surface is more often affected than the anterior. Anterior lenticonus can be readily seen by oblique illumination. The posterior form is determined by the ophthalmoscope, as in the center of the field there is a sharply outlined disk having the appearance of an oil globule. Opacities in the lens may also be present.

*Coloboma of the Lens.*—This is also a rare condition. It usually is found in the lower margin of the lens. The defect may be very slight, or one-fourth of the lens may be lacking. One or both eyes may be affected, and coloboma of the iris, choroid or ciliary body is often also present. There is also often a defect in the suspensory ligament. Congenital displacement, smallness or partial opacity of the lens may be associated with the coloboma. These eyes usually show a myopic condition. The cause of this defect is probably due to defective development of the suspensory ligament.

*Ectopia Lentis* (Dislocation of the Lens).—This is usually in both eyes, although it may occur in only one. It is not often seen. According to Knapp, 1 in 5000, The dislocation may be in nearly any direction excepting downward. Usually it is upward. In microphthalmic eyes it is sometimes backward through vitreous defects.

Symmetrical displacement is the rule, but is not invariable. Monocular diplopia sometimes occurs. In ectopia the iris is tremulous, and the anterior chamber irregularly deepened. Oblique illumination will show the curved edge of the lens, the lens showing gray. Ophthalmoscopic examination will show the edge of the lens as a dark curved line. These lenses are usually abnormal in size or shape. Defective development of the suspensory ligament, as in coloboma, is the probable cause of this condition. Heredity appears to be a factor. Increased tension may occur in these cases if the lens falls forward.

**CATARACT.**—Properly an opaque condition of the lens. If an opacity of the lens capsule exists it is called capsular cataract, and when both lens and capsule are affected, the term capsulo-lenticular is employed. A cataract may be primary, secondary or symptomatic. Primary when the morbid condition commences in the lens, secondary when resulting from morbid processes in other tissues of the eye, symptomatic when the result of an injury or general disease. Cataract may be partial, and remain in this condition, or



progressive, when eventually the entire lens becomes opaque, and the term complete is used. The color may be white, black or amber. Clinically, cataract has been divided under different headings according to the character of the opacity and its consistency.

1. **SENILE.**—This form is hard (the nucleus being large), and develops usually after the age of forty-five. The rapidity of the development varies. In some cases the cataract will become mature or ripe in a few months, while in others it may remain stationary for years. The hardened nucleus may be recognized by its brownish or yellowish tint. When the nucleus is small and the cortex of a uniformly white color, the opaque lens is comparatively soft. A large nucleus with a marked gray, yellow or brown color, distinguishes a true and hard cataract.

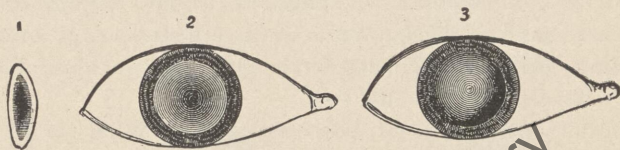


FIG. 63.—Nuclear Cataract. 1. Section of Lens, dense opacity central. 2. Ophthalmoscopic appearance. 3. Appearance by oblique illumination. The pupil dilated by a mydriatic.—*Modified from Nettleship.*

When the nuclear sclerosis invades the cortical portion, giving a brownish color to the entire lens, the pupil may be black, and what is called *black cataract* results. In some cases crystals of cholesterol are found, and can be distinguished by their bright, glistening appearance. They may occur in either the juvenile or senile types. As a rule senile cataract affects both eyes, one often being more advanced than the other.

**CONGENITAL OR JUVENILE CATARACT.**—This type may be partial or complete, but is comparatively infrequent. The lens, in the complete form, is soft and presents a dense opacity, white or with a bluish tint. The eye is often nor-

mal in other respects. Morbid changes in the retina, choroid, or optic nerve however, may be present, as well as defective development, as coloboma, hydrophthalmos or microphthalmos. Heredity appears to be a factor in these cases when the cataract develops during the early years of life, but in the congenital type it does not seem to have much influence. It is at times very difficult to determine whether the opacity is prenatal or not, as a careful examination of the eyes of the newly born is seldom made.

2. AXIAL CATARACT.—An opacity of the lens in the antero-posterior axis extending part or all the way through. It may be an irregular spindle shape, and is sometimes associated with opacities in other portions of the lens. When the balance of the lens is clear however, there may be a fair amount of vision, but there is nearly always a lack of elasticity of the lens, and the accommodative range is diminished. This form is congenital, evidently forming in the early development of the lens.

Either anterior, polar, posterior polar, zonular, or central cataract have been found with the congenital type. A form resembling the congenital type may develop after birth, and is nearly always associated with central capsular cataract.

POLAR CATARACT (Anterior Capsular, Pyramidal Cataract).—This form may be congenital or acquired. In the former, it generally occurs in both eyes, while in the latter but one may be affected. There is a small white opacity, or a pyramidal-shaped mass sometimes drawn to a point, at the anterior pole of the lens. In the congenital type, it is probably due either to adhesion of the pupillary membrane and capsule or to fetal inflammation, lymph being deposited on the capsule. In the acquired form it results from a central corneal perforation through which the aqueous escapes, and the lens is pushed forward against the posterior corneal surface. Lymph being deposited in the perforation and on the capsule, the escape of aqueous is checked, and the anterior



chamber filling, the lens recedes, carrying a deposit of lymph with it. In this form there will also be a corneal macula. This condition not infrequently follows gonorrheal conjunctivitis.



FIG. 64.—Polar or Pyramidal Cataract. Section of the lens, and as seen on direct inspection.—*Modified from Nettleship.*

If the cataract is small, provided the balance of the lens is clear, the vision may not be much affected, but in bright light there will be lessened acuity of vision on account of the pupillary contraction.

**POSTERIOR POLAR CATARACT.**—This opacity may be congenital, and when it is, it results from the remains of a hyaloid artery. It can be detected with the ophthalmoscope.

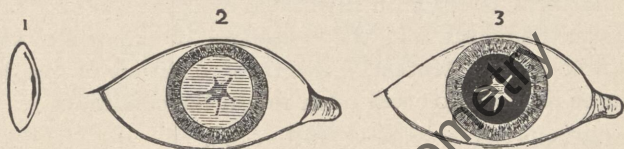


FIG. 65.—Posterior Polar Cataract. 1. Section of lens showing position of opacity. 2. Ophthalmoscopic appearance. 3. Appearance by oblique illumination. Pupil dilated by a mydriatic.—*Modified from Nettleship.*

A stellate form of cataract occurs at the posterior pole, but is in the lens substance. This form may result from retinal, choroidal or vitreous disease. This condition often remains stationary, but it may be progressive, finally becoming complete.

**ZONULAR CATARACT (Lamellar Cataract).**—This is the most frequent congenital form, but it may develop after birth. As a rule, both eyes are affected. Generally stationary, but sometimes is progressive. The nuclear portion may

be clear or partially cloudy. This is surrounded by a zone of opaque lens substance, which is enveloped by an apparently normal layer of cortical material. There may be two

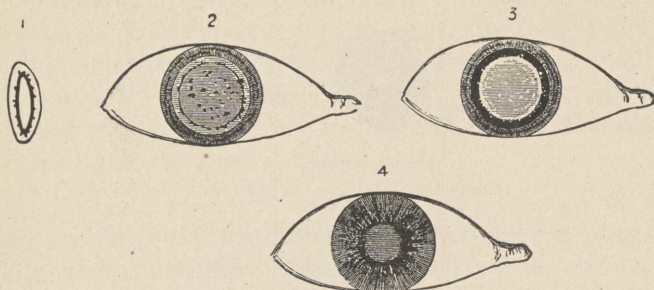


FIG. 66.—Zonular Cataract. 1, 2, 3, same as 65. 4. Undilated pupil showing a slight gray, as the opaque layers are deep-seated. —*Modified from Nettleship.*

or three opaque zones alternating with the clear ones. When the haziness is slight, a superficial examination may fail to discover the defect, and the complaint of dimness of vision will first direct attention to the true condition of the lens. Oblique illumination will often reveal the condition.

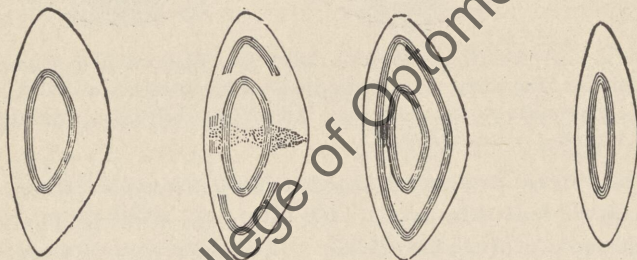


FIG. 67.—Sections of lenses, showing varieties of zonular cataract.

Ophthalmoscopic examination under a mydriatic will show the central area as dark, with the surrounding reddish portion representing the clear periphery of the lens. In the multiple type there will be concentric rings varying in intensity.



The refractive condition of the eye may be either myopic or hyperopic, but the patient will hold close work in a manner similar to marked myopes.

In the congenital form there is probably some defect in the development of the lens; in the cases developing during infancy, faulty nutrition is probably a factor. The condition is oftenest found among poorly developed, rachitic and feeble children. According to Horner, it is coincident with the development of rachitic teeth. Frequently it will be found that these patients were subject to convulsions during infancy. Lawford describes this cataract as a narrow zone of degenerated fibers between the nuclear and cortical portions. The disturbance of vision depends upon the density of the opacity.

PUNCTATE AND STELLAR CATARACT.—A rare form of partial congenital cataract, in which the opacities consist of small dots, situated either at the center or throughout the lens substance. The arrangement of the dots is frequently that of the lens sectors, thus presenting a stellate appearance. This form may remain stationary a long time, but may be progressive.

CENTRAL CATARACT (Nuclear Cataract).—A congenital form sometimes seen. It is distinguished from zonular cataract by being more densely white at the center; the balance of the lens may or may not be clear. Oblique illumination or the ophthalmoscope will determine the character of the opacity. Probably due to defective development during early pregnancy. Visual acuity will depend upon the amount of the lens affected. Nystagmus is frequently present in this as well as other forms of congenital partial cataract.

TOTAL CATARACT (Complete Cataract).—This congenital form results from fetal malnutrition or disease, and as this may occur at any time after the formation of the lens vesicle, the stage of development of the cataract at birth varies. If incipient at birth, it may be rapidly progressive.

The color is white, or bluish-white, and the lens is soft. According to Becker, a total cataract at birth may be either soft or the cortical substance may have undergone liquefaction, leaving a dense central portion, which drops to the bottom of the capsule (*Morgagnian cataract*), or this central portion may be absorbed.

CATARACT OF ADOLESCENCE.—This form varies in consistency and frequently develops rapidly. The softer the lens the closer the color is to that of skimmed milk. The nuclear and cortical portions of the lens become cataractous, frequently being completely fluid. Infiltration of lime salts is not infrequent in this form, and may cause the entire lens to be solid. Shrinking of the soft cataract of adolescence usually occurs, when the sac will be small and the walls thickened. In this form of cataract, diabetes should be looked for, as there are no clinical features distinguishing diabetic from other types of adolescent cataract.

TRAUMATIC CATARACT.—This form is the result of an injury to the eye; it may be by concussion without rupture of the capsule, but most frequently is found after a penetrating wound, injuring the capsule and lens. Cataract seldom follows contusion of the eye, unless damage to the deeper structures results, but when it does it is called *concussion cataract*.

In penetrating wounds, where the capsule is injured, the aqueous entering through the rupture, opacity and swelling of the lens results. If the laceration is at all extensive the cortex swells, and some of it escapes into the anterior chamber. Absorption of the lens matter may take place, especially in young subjects, the time required being about six weeks, but an iritis, scleritis, or secondary glaucoma may result. When the rupture of the capsule is slight, the resulting opacity may remain stationary, or in some cases disappear, but it may also increase to a complete cataract.

SECONDARY CATARACT (After Cataract).—These terms are used to designate changes in the lens capsule remaining after extraction. Sometimes the anterior capsule, instead of



retracting after an operation will close. In disquisitions the anterior capsule always remains, and may develop an opacity or become thickened and irregular, interfering with vision. In cases where the cortex is comparatively soft there may be enough lens matter remaining after extraction to prevent capsular contraction. This lens substance may not all be absorbed, but will more or less fill the pupillary space, considerably lowering vision, or the retracted capsule may imprison the lens matter, preventing absorption. There may be an opacity or thickened condition of the capsule prior to the operation. The term is also used to designate plastic exudation, lymph deposits, and occlusion of the pupil following an unsuccessful cataract operation.

**CAPSULAR CATARACT.**—This is applied to deposits or any thickening or proliferation of the epithelial cells of the capsule. They may be congenital or acquired. When acquired they may result from a corneal ulcer, or an inflammation in which extensive synechiæ are formed between the iris and capsule. This form often extends over the entire capsule through the interference of nutrition.

Detachment of the retina, irido-choroiditis, etc., are often followed by this form of cataract through cell degeneration. In hypermature cataract the capsule is especially liable to present degenerative changes.

**CAPSULO-LENTICULAR CATARACT.**—As the name implies, is where the lens and capsule are both affected. The anterior cortical portion of the lens is usually the part affected, the opacity being in this portion of the lens, and the capsule is also generally thickened.

*Symptoms.*—The senile type is usually taken as exemplifying the line of symptoms found in cataract :

1. *Visual Changes.*—Diminution of vision depends upon the extent and location of the opacity. If central, the patient can often see better in a moderate light ; if peripheral, a bright light will give the best vision. In the incipient stage the refraction may be increased through swelling of

the lens. "Second sight," as it is termed, in which the aged dispense with their reading glasses, is pretty good evidence of cataractous changes. Astigmatism may occur in these cases, or it may change an astigmatism "with the rule" to one "against the rule."

2. *Conjunctival Hyperemia*.—Not always present, but when it is, it results from the strain necessary to see through the morbid lens.

3. *Pain, Photophobia*.—Not marked. In some instances there will be a dull pain referred to the orbital region. Protection of the eyes by tinted glasses will sometimes relieve both the pain and dread of light.

4. *Monocular Diplopia, Polyopia*.—During the incipient stage either of these conditions may be present.

5. *Anterior Chamber*.—This varies. It may be normal in depth; if the lens is swollen, shallow; or with a small lens deeper than normal.

6. *Iris*.—This usually is normal, but at times there is immobility. The appearance of the pupil varies according to the stage of the development as well as the color of the lens. Without illuminating the eye, the pupil will look normal in the incipient stage, but with advancement of the morbid process the color may vary from a gray, white, yellow or brown, and in the deeper colored, dark brown lens, the pupil may look black (black cataract).

Progressive cataracts are divided by Fuchs as follows:

1. *Incipient Stage*.—Opaque spots with intervening clear spaces. The opacities usually are in the shape of sectors or spokes, the apex pointing inward.

2. *Swelling Stage*.—As the opacity increases and more fluid is absorbed, the lens swells, pushing the iris forward and lessening the depth of the anterior chamber. As long as the opacity has not reached the anterior capsule, a light held to one side of the eye will cause a shadow to be seen at the pupillary margin on the side from which the light comes. The lens is bluish-white, with a silky luster, and the stellate



markings are easily seen. During this stage the lens becomes completely cataractous and gradually returns to its normal size through loss of water in its substance.

3. *Mature*.—Normal anterior chamber, and no iris shadow. The bluish-white iridescent appearance has given place to a dull gray, or brownish color, and the markings of the stellate figure are not entirely obliterated. In this stage the lens is easily separated from the capsule, and it is the most favorable time for extraction.

4. *Hypermature*.—In this stage there is disintegration of the cortex, and a soft pultaceous, structureless mass remains, or absorption of the fluid continues, leaving an inspissated, dry, cake-like mass, with a deepened anterior chamber. The sector markings are not seen in either of these conditions.

*Diagnosis*.—The necessity of using the ophthalmoscope in these cases cannot be too strongly insisted upon, simple inspection of the pupil will often lead one to diagnose cataract when simply senile changes in the lens are present. With advanced years, the lens usually becomes straw-colored, reflecting more light than in younger persons, and on account of this peculiar luster, cataract is often diagnosed.

The old *catoptric test* may be used when one has no ophthalmoscope. This test will also determine black cataract or presence of the lens. The patient's pupil should be dilated with cocaine or homatropine, then in a darkened room a lighted candle should be moved before the eye. If the eye is normal three images are seen, two erect and one inverted, the erect ones being from the anterior surface of the cornea and lens, the inverted from the posterior surface of the lens. The first image is bright, the second somewhat diffuse, and the inverted one comparatively clear. When the inverted image is absent the lens is opaque, and if the second erect image is lacking the capsule is involved.

In the ophthalmoscopic examination dilatation of the pupil will be necessary in many cases. Location of the opacity

can then be determined with accuracy, showing whether the morbid process is nuclear or peripheral. The reflected light will be interrupted either by spots, lines or rings depending upon the stage of development and form of the cataract. If nuclear there will be haziness at the center of the lens. The lens sectors may be more dense than normal, or there may be the appearance of cracked glass. When there is complete absence of reflex, an opaque lens is present. Dilatation of the pupil is necessary to determine whether the entire lens is affected or not.

Oblique illumination will show the opacities as whitish spots or lines.



FIG. 68.—Cortical Cataract. 1. Section of lens showing opacities. 2. Ophthalmoscopic appearance. 3. Appearance by oblique illumination. A mydriatic has been used.—*Nettleship*.

The rapidity of development in progressive forms varies. The cataract may become mature in a few months, or it may take years, usually from one to four. Cortical cataract as a



FIG. 69.—Shadow of the iris seen from the front, being on the same side as the light.

rule is slow in maturing. Some give fifteen or twenty years as the time required. The mature stage as before described is determined by illuminating the pupil by means of a light placed at the side of the face. The deeper the semicircular shadow cast by the iris on the lens the less complete the



opacity. When no shadow is present the opacity is complete, but if there is a red glare transmitted, or shining sectors are seen, the cataract is not mature. In hypermature cataract there will be a shadow, but the lens surface is flat.

Brailey classes the senile nuclear form as a degeneration, and the cortical as being in the nature of an inflammation.

Equatorial opacities are those commencing at the edge of the lens in the cortex and give the striated appearance to the lens. These are contained in both the outer and posterior portions, and gradually approaching the center, the nucleus becomes sclerosed and hazy. Opacity of the cortical portion increases until mature cataract results. Mixed cataract is the term often applied when the nucleus and cortex are both implicated. Schoen states that senile cataract always commences as equatorial, the nuclear opacity being secondary. Cataracts may commence as a diffuse cloudiness or as small points through the cortex, or opacities may appear by ophthalmoscopic examination as dark, flocculent spots.

Morgagnian are those hypermature cases in which liquefaction of the cortex has taken place and the nucleus in the shape of a flattened disk has become displaced. A tremulous condition of the iris is usually seen in hypermature cataract.

Diabetic cataracts may be spontaneously absorbed.

Under the age of thirty-five, cataracts are classed as soft, as the nucleus is small or lacking.

CAUSES OF CATARACTS. (1) Age. Mature cataract is most frequent after the age of fifty, although sometimes found in adolescence without any assignable cause. (2) Sex does not seem to be a factor, excepting possibly in the zonular type, when females seem to be the most subject. (3) Disease. Diabetes mellitus occurs in about one per cent. of cases. Albumin has been found in about six per cent. Cataract has been reported in cases of gout, syphilis, epilepsy, bronchocele, some skin diseases, rachitis and idio-

pathic fevers. (4) Occupation. Glass blowers have been credited with being especially liable to cataract, supposedly the result of both light and heat. Puddlers and workers in blast furnaces should also show the same tendency. (5) Heredity. This is undoubtedly a factor in many cases. (6) Toxic agents. Cataract has been noticed during ergotism epidemics (*raphanic cataract*), especially in the convulsive type. It is a question whether the ergot or the convulsions are the cause. (7) Traumatic. This form has been described, but those cataracts following a stroke of lightning are placed under this heading. They may be partial or complete and one or both eyes may be affected. In these cases there may be myosis, mydriasis, choroidal rupture, iritis, optic neuritis, optic atrophy, irido-cyclitis, or paralysis of accommodation. (8) Eye Diseases. Secondary cataract may follow many acute and chronic diseases; corneal diseases, especially ulcerative; glaucoma; detachment of the retina; iritis, irido-cyclitis, irido-choroiditis, and choroiditis. (9) Accommodative strain. Undoubtedly eye strain is a factor in many cases. Hyperopia and astigmatism, by producing congestion of the ciliary body, may interfere with nutrition of the lens, cataract resulting. In many cases no cause can be assigned.

*Prognosis.*—In incipient cataract with the striæ in the anterior portion of the lens, the diminution of vision will probably be slow. Spontaneous disappearance or absorption seldom occurs. Operations for cataract are not usually performed until they are mature or nearly so, and the advisability of an operation will depend upon:

1. *The Interior Condition of the Eye.*—As frequently occurs the eye is not seen until the lens has become so opaque that an ophthalmoscopic examination is impossible, and other means of determining the condition must be employed. A lighted candle placed about 4 meters (12 or 13 feet) in front of the patient, the sound eye being covered, the flame



should be recognized. This indicates that no marked changes have occurred in the macular region.

The "projection of light" or "light field" is taken by having the patient fix the eye in one position and moving a candle, or throwing the reflection from a light on the eye by means of the ophthalmoscopic mirror. The light should be thrown onto the pupil from all points, so as to describe an entire circle in order to determine the condition of the retina. If the patient indicates accurately the direction of the light, it shows the receptive portion of the eye is not markedly diseased and projection is called good. If the direction of light is not indicated accurately, or is not perceived, gross changes are probably present, such as choroiditis, glaucoma, optic atrophy, detachment of the retina, etc.

A tremulous iris is a bad symptom, as usually the vitreous is fluid with this condition. Absence of light perception, or tremulous iris are unsuitable cases for operation. Good vision does not always follow a perfect operation, even with a careful projection test, as a small central choroiditis may be present.

2. *Refractive Condition.*—This often cannot be obtained, but when it can, the prognosis in high myopia is unfavorable. Hyperopia, other things being equal, will give the best results.

3. *Age and General Health.*—Advanced age is not a hindrance to a successful operation. In diabetic and albuminuric patients, although a complication, it does not contra-indicate extraction. Extreme debility, dementia, dacryocystitis, naso-pharyngitis or chronic bronchitis are considered unfavorable conditions.

4. *Mobility of the Iris.*—Immobility to light or a mydriatic, may indicate defect of the optic nerve, or iritic changes.

5. *Condition of the Eye and Appendages.*—Trachoma, blepharitis, or chronic conjunctivitis, contra-indicates an operation, as infection is very liable to occur.

6. *The Kind and State of the Cataract.*—The size and position of the nucleus, condition of the cortex, primary or secondary cataract, and maturity, must be taken into consideration.

In total congenital cataract, anomalous conditions must be considered as well as in the lamellar form.

In traumatic cataracts the probable injury to other structures must be considered.

**TREATMENT.**—This depends upon whether the cataract is mature or immature. There is no known drug or measure that will produce absorption of cataract. In some few isolated cases absorption has taken place, especially in the traumatic type, but the process of absorption is evidently independent of any remedy used, unless it is one that places the secretory and excretory functions in better condition, thus improving general nutrition. The interdependence of the eye upon general health is too well known to need comment. In many instances the comfort of the patient can be improved, even if it does not retard the development of the opacity :

(a) By carefully fitted and adjusted lenses. My rule is, if the opacity is central to have the lens made of the first tint, this will tend to dilate the pupil somewhat, and still not obscure reading or work. The eyes should be carefully examined every three or four months to correct any changes which may occur. Moderate use of the eyes is undoubtedly an advantage in these cases, but over fatigue must be avoided.

(b) Congestion in the ciliary region may be relieved by giving two drop doses of *Laborandi* three or four times a day. Habitual constipation should be relieved by appropriate measures, small doses of *podophyllin* being the most generally useful. *Chionanthus* and *chelidonium* in hepatic torpor will afford relief. *Nux* and *hydrastis* in wrongs of the stomach will often also relieve the asthenopic symptoms.

(c) In cases where the opacity is peripheral the use of a solution of sulphate of *eserine* (1-3000) may be grateful to



the patient by producing myosis and increasing visual acuity.

*Artificial Ripening.*—In some cases the progress is so slow that the patient desires hastening of the process. Different means have been advocated for hastening maturation. Corneal paracentesis with external massage as practiced by Pooley and White seems to be the least objectionable. However it is questionable whether any procedure is advisable.

*Immature Cataract Extraction.*—At about the age of sixty the normal accommodation is practically abolished and the operation may be successfully performed, although some of the cortex may remain, and swelling cause an iritis. When possible it is better to wait until maturity. Knapp prefers extraction of an immature cataract to artificial ripening.

*Mature Cataract Extraction.*—The operation depends upon the patient's age and the kind of cataract. After the age of forty, the cataract is usually hard and one of three methods is employed: (1) Simple extraction, or the flap operation without an iridectomy; (2) the modified or peripheral linear operation. (Von Graefe). (3) short or three millimeter flap. (De Wecker).

Cataract occurring before the age of thirty-five is soft and may be removed by (1) linear extraction, (2) discission or needle operation, or (3) suction. Before the age of twenty-five a soft cataract may be removed through a linear corneal incision, or if semi-fluid by suction.

Total cataract of youth as well as complete congenital cataracts, are removed by discission, as a rule, the time for operating in the latter class being after dentition is complete.

The partial congenital form (central or lamellar) may have either a discission or an iridectomy performed. If there is enough improvement after mydriasis has been obtained to justify an iridectomy, it should be performed, the artificial pupil being made opposite the clearest portion of the lens.

If satisfactory vision does not result, needling or the removal of the entire lens may be done. In after cataract, discission is employed.

Punctate, fusiform, or polar cataracts are seldom amenable to operative measures.

After the removal of monocular cataract, there will not be increased acuity of vision on account of the unequal refraction. The operation may be performed for the cosmetic effect, to prevent hypermaturity, or to improve the visual field of the affected eye. In cases having divergence, an advancement of the internal rectus may have to be performed later. Glasses should not be adjusted after a successful operation until all redness in the ciliary region has subsided. It is a safe rule to wait ten or twelve weeks before fitting with glasses, as by this time the astigmatism, which soon after the operation is usually considerable, will subside as cicatrization becomes complete. The astigmatism is nearly always against the rule. This should always be corrected.

An eye in which the lens has been removed is called an *aphakic eye*, or *aphakia*, and if the eye was emmetropic, a hyperopia of about 11.00 D. will be present. If myopia was present the amount of hyperopia will be diminished, and in some cases the myopia may have been of such a degree that the absence of the lens will neutralize the error. Ordinarily, a + 10.00 D. sph., combined with a suitable cylinder, will give correction for distant vision, and for close work about a + 3.00 D. sph. must be added to the distance lens. The vision after an operation varies. In many cases perfect acuity is obtained or 20-20, but, as a rule, a less amount will have to satisfy both patient and operator. Some operators place a vision of 20-200 or 1-10 in the successful list. Division of the remaining lens capsule will often increase visual acuity. (See operations for cataract).

DISLOCATION OF THE LENS (*Luxatio Lentis*).—Besides the congenital condition, a so-called spontaneous dislocation



of the lens is sometimes seen, and may be due to some eye diseases where nutritive changes have occurred in the vitreous and suspensory ligament. Traumatic dislocation is not infrequent. It may be partial or complete. If complete, the lens may be forced backward into the vitreous, forward into the anterior chamber, or escaping through a rupture in the globe, may be found under the conjunctiva, and rarely under Tenon's capsule.

*Symptoms.*—When partial, the curved edge of the lens will be seen as a dark ring by an ophthalmoscopic examination. The iris is tremulous through lack of support and rupture of the suspensory ligament. Monocular diplopia and diminished or absent accommodation are present. If complete, the symptoms are similar to those found after a cataract operation, but if the result of a traumatism, hemorrhage, or some other evidence of the injury will be present, if the case is seen soon after the accident has occurred. As a rule, the dislocated lens becomes cataractous. Iritis or glaucoma may also follow.

*Treatment.*—In the partial form of traumatic dislocation, a few cases have been recorded in which the tissues seemed to repair and the lens resumed approximately its proper position. Even if this does not occur, vision can sometimes be improved by the proper correcting lenses. If there is complete forward dislocation into the anterior chamber, the lens may be extracted through a corneal incision. If the dislocation is backwards into the vitreous, and irritation follows, the lens should be removed. (See operations).

When the lens is dislocated beneath the conjunctiva, or under Tenon's capsule, it can be removed through a small conjunctival incision made over the lens, cutting deeply enough to reach the lens. The eye in all such cases should be treated the same as after a cataract operation.

**FOREIGN BODIES IN THE LENS.**—As a rule, these will produce a general opacity. In some instances, when the

penetrating body is small and aseptic, the opacity may remain circumscribed. Iron or steel particles may sometimes be removed by means of an electro-magnet. The powerful electro-magnet of Haab will frequently remove such particles even from the deeper layers of the lens.

An opaque lens, containing a foreign body, should be removed, as the foreign body may be displaced and sympathetic ophthalmia result.

The employment of the X-rays will usually determine, not only the presence, but also the location of a foreign body.



## CHAPTER XII.

### DISEASES OF THE VITREOUS.

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ANATOMY.—Enclosed within and filling the posterior cavity of the eye is a transparent, colorless, gelatinous body, the vitreous. Surrounding the vitreous is the fine transparent *hyaloid membrane*. It presents a concavity in front, the *hyaloid fossa*, which is occupied by the lens, the balance of the membrane conforming to the interior surface of the vitreous chamber, being in contact with the retina, optic disk and ciliary body.

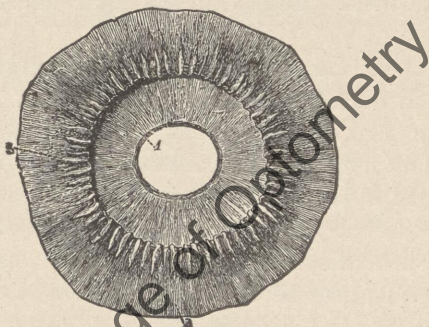


FIG. 70.—Ciliary Processes, seen from behind. 1. Posterior surface of the iris with the sphincter muscle of the pupil. 2. Anterior part of the choroid. 3. one of the ciliary processes.—*Kirke*.

The vitreous is composed of a delicate, transparent mesh work, containing a semi-fluid substance. The hyaloid canal or central lymph space passes from the optic disk forward to the lens; this is the remains of a perivascular space (canal of Cloquet), which surrounded the hyaloid artery during

fetal life, later being converted into a lymph canal. The vitreous contains some connective cells and leucocytes. These sometimes may be noticed by the patient as floating before the eyes (*muscæ volitantes*). Cholesterine crystals are also sometimes found in the vitreous by the aid of the ophthalmoscope. While the vitreous is abundantly supplied with arteries during fetal life, these degenerate after birth, and nutrition is evidently maintained through the retinal or choroidal vessels. This would account for the prevalence of vitreous changes in diseases of the retina and choroid. Changes in the vitreous are often independent of disease of this body, but are classified as morbid conditions, as frequently no other visible disease is found.

**HYALITIS.**—This term should refer to disease of the vitreous and not the hyaloid membrane. Two types of inflammation are recognized, the suppurative, and where opacities are found. Almost invariably hyalitis results from penetrating injuries, diseases of the optic nerve, retina, or choroid.

**PURULENT OR SUPPURATING HYALITIS.** Penetrating wounds in the ciliary region, even without the retention of a foreign body in the vitreous, are the most general causes of purulent hyalitis. The disease usually commences within forty-eight hours after the injury, but may be delayed for months or even years. Whether purulent choroiditis is ever a cause is a disputed point. Purulent retinitis, combined with cyclitis, may be a factor. Possibly a spontaneous inflammation of the vitreous may result in suppuration. According to DeSchweinitz, it may be a product of metastatic choroiditis, following inflammation of the cord in the newly-born, or following scarlet fever, relapsing fever, erysipelas, etc. General debility, resulting from low grades of fever or infectious diseases, may be factors in pus formation in the vitreous.

**Symptoms.**—When the cornea and lens are clear a yellowish reflex is seen through the pupil. The periphery of the



iris is retracted and the free border is bulging. Diminished tension and often synechiæ are present. The iris and ciliary body are generally affected, and then the characteristic pericorneal red zone will be present. If the pus is localized, the condition is sometimes mistaken for glioma of the retina, and the term *pseudo-glioma* is applied. The symptoms given, and the history of the case, should differentiate between the two conditions. The possibility of this complication in low types of fever should be remembered, and the eyes carefully watched for premonitory symptoms.

*Treatment.*—After the formation of pus has occurred, medicinal measures will not save the eye. Destruction of the vitreous and shrinking of the eye usually follow, and enucleation of the eye is generally advisable. If opacities are discovered in the vitreous, especially in debilitated subjects, proper treatment may save the eye. The treatment should be such as will improve nutrition. If there is a suppurative tendency either of the lymphatics or skin, sulphide of calcium or lime water should be administered. Lymphatic disturbances would indicate phytolacca or iris versicolor. In anemia the iodide of arsenic should be given. For promoting absorption of the opacities, jaborandi.

VITREOUS OPACITIES.—These occur either as floating or stationary opacities. The mobility of the floating ones will vary according to the consistency of the vitreous. They may appear as fine dust, threads, or flakes of different sizes. In some cases the shape simulates closely some animate object, and prior to the discovery of the ophthalmoscope many cases of supposed hallucination were evidently victims of vitreous opacities. At times the entire vitreous is affected and vision is much diminished, although reading vision may be much better than distant. One or both eyes may be affected.

Stationary opacities are generally adherent at one or more points and are usually membranous. The points of attachment may be the retina, choroid, optic disk, ciliary processes,

or at times on the posterior capsule of the lens. This form may assume either a dense membrane, or fine bands, the latter usually running from before backwards. A single fixed opacity is sometimes seen in a healthy eye, and probably is a congenital non-inflammatory defect, but visual disturbances seldom occur in this form.

*Diagnosis.*—The subjective symptoms depend upon the density and amount of opacity. Central vision may be normal or completely destroyed. Patients describe the appearance as black or gray spots, sometimes assuming the shape of animals or insects, and again as fine mist falling between them and the object looked at, depending upon the character and number of opacities. If the vitreous alone is affected, there may be no change in the field of vision, while redness of the eye or pain will be absent.

*Objective Examination.*—The direct ophthalmoscopic examination will show the opacities. The mobility of the floating particles will depend upon the consistency of the vitreous, the more fluid the more rapid the motion. These move in the opposite direction to the movement of the eye, if the eye is moved to the right the opacities move to the left; this rule holds true in whatever direction the eye moves; corneal or lenticular opacities move in the same direction as the eye. Vitreous opacities continue moving after the eye stops and slowly settle; while corneal or lenticular opacities stop their movement when the eye comes to a rest.

Oblique illumination will also determine the location of the latter. With the direct ophthalmoscopic examination the location can be determined by getting the optic disk, then bringing stronger and stronger + lenses before the aperture of the mirror until + 16.00 D. is used. This will bring the different vitreous layers into view from the fundus to the anterior portion. The positions maintained by both patient and observer must be those directed for the direct, or upright image. The indirect ophthalmoscopic examination can be used here to advantage in many cases, and is use-



ful for corroborative diagnosis, especially when the opacities are in the posterior part of the vitreous. In this method the convex lens held in the hand is gradually withdrawn from the observed eye, bringing different portions of the vitreous into view. The lens must be steadily held in this method, as the area is very much diminished. This method is more applicable however for fixed opacities than floating ones.

*Causes.*—1. *Refractive Errors.*—A high degree of myopia with choroidal changes and posterior staphyloma, is probably the only refractive condition that will produce this.

2. *Eye Diseases.*—The fine dust-like variety (*hyalitis punctata*), confined to the back part of the vitreous, as a rule results from specific choroido-retinitis. When the form is restricted to the anterior portion, it usually follows a serous cyclitis, which in many cases is of tubercular origin, and an iritis may also follow. There may also be found with this dust-like form, large floating flakes. When the opacities assume the form of threads or flakes, a disseminated choroido-retinitis is to be suspected; in elderly persons they often result from hemorrhages of the choroid. A chronic and severe choroiditis may cause membranous opacities, which are often associated with hemorrhages from the ciliary body. These at times become more or less organized, sometimes are vascular and may be attached to the vitreous chamber at some point.

3. *Injuries.*—A traumatism may cause hemorrhage from the ciliary body, or choroid, resulting in opacities, but supuration is liable to occur in these cases.

4. *Systemic Diseases.*—Infectious diseases, typhoidal types of fever, hepatic congestion, habitual constipation, menstrual irregularities, gout, rheumatism, so-called malaria, anemia, as well as the long continued use of arsenic, may produce vitreous opacities.

5. *No Known Cause.*—In many cases no known cause can be assigned. Fine thread-like opacities are not in-

frequent in old persons where no other morbid condition can be found, and are probably the result of senile changes.

*Prognosis.*—This will depend upon the cause. It is bad in all cases of purulent disease of the choroid, or purulent hyalitis. When due to syphilis, or some systemic condition which can be benefited by treatment, fairly satisfactory results may be obtained. Hemorrhagic opacities may be partially absorbed, but the tendency to recurrence must be remembered.

*Treatment.*—If eye strain is supposed to be a factor, the error should be corrected by suitable lenses, warning the patient against close use of the eyes. If syphilis or other constitutional disease, which will yield to treatment, is the cause, improvement will usually follow. Hemorrhagic opacities are less satisfactory to treat. Iodide of potassium is usually of no use excepting in specific disease, and as a rule small doses will be best. Jaborandi is one of the best drugs for promoting absorption, but it should be given in doses just within the physiological limit, gtt. iij to v usually. Bryonia is also a valuable remedy in these cases giving doses of gtt.  $\frac{1}{3}$  to ss. If any suppurative tendency is present sulphide of calcium or lime water. Portal congestion will be relieved by chinonanthus or chelidonium. Gouty diathesis by colchicum. Rheumatic conditions by salicylic acid, with cimicifuga, bryonia, or thus as indicated. Menstrual wrongs by jaborandi, thurnum prunifolium, or cimicifuga. Habitual constipation by such measures as will relieve the condition.

Dense membranous opacities are seldom amenable to treatment. Division of these is sometimes done when they are fixed at two or more points, using a very narrow knife or cutting needle, making the puncture through the sclera between the insertions of the external and inferior recti muscles, but the operation is successful only in a small number of cases.

MUSCÆ VOLITANTES (Myodesopsia).—This term is applied to the black specks often noticed floating in the field of



vision. They may often be noticed in reading or looking at uniformly illuminated surfaces. A sudden upward movement of the eye will bring them into view, and they will be seen to gradually settle until they pass from view. There are no true opacities in this condition, and the ophthalmoscope reveals nothing. According to Fuchs, they are the opaque remnants of embryonic cells. In myopes they are often troublesome. This condition is not serious, but in nervous persons it will often cause an excessive amount of annoyance and irritation. Whether the popular belief that dyspepsia and liver trouble aggravate the condition is a question. The patient should be advised to disregard these floating objects, as otherwise there will often be a continual search for them.

*Treatment.*—If there is any refractive error it should be corrected, as this will often divert the patient's mind. Systemic measures will, in some instances, afford relief, but as long as these specks are not numerous there is seldom any discernible diseased condition.

**LIQUEFACTION OF THE VITREOUS (Synchisis).**—A fluid condition of this body is evidence of more or less disturbance of the transparent frame work of the vitreous, a liquid mass resulting. Only an ophthalmoscopic examination will reveal this condition through the free movement of the opacities, which are usually present. In some instances the vitreous may not be fluid, but there may be an accumulation of fluid between the retina and hyaloid membrane. This usually is at the anterior and posterior divisions of the vitreous (*anterior and posterior detachment of the vitreous*). A tremulousness of the iris may be present, and also of the lens, which in the later stages of the disease may be spontaneously dislocated. Through lessened volume of the vitreous, the tension may be diminished, and detachment of the retina, or even atrophy of the globe may follow. Either of these conditions is always the result of other diseases of the eye, as retinitis, choroiditis, high degrees of myopia, etc. In cataract operations the possibility of this condition being present must be remembered.

*Treatment.*—Jaborandi in gtt. j to ij, combined with bryonia gtt.  $\frac{1}{3}$  to ss, will improve the condition in many cases. If there is a syphilitic taint, red iodide of mercury and iodide of potassium will be indicated. Nux vomica or hydrastis will often prove beneficial in wrongs of the alimentary canal. Chionanthus and chelidonium in hepatic affections. In fact, any remedy that will improve nutrition will be an aid in this condition.

SYNCHISIS SCINTILLANS (Sparkling Synchisis.)—Claimed by some to be a senile change only, and occurs usually after the age of seventy, and never under the age of sixty. By some it is supposed to occur most frequently in alcoholic individuals, or where there is a tendency to arthritic disease. The vitreous is fluid, and contains, according to Poncet, cholesterine and tyrosine. The ophthalmoscopic appearance is that of a shower of brilliant crystals when the observed eye is moved. Vision is seldom much affected.

*Treatment.*—So far as known, no medication will give any relief. When this disease exists operative measures are always contra-indicated.

HEMORRHAGE INTO THE VITREOUS.—As given under vitreous opacities, hemorrhages may occur from the ciliary body, retinal or choroidal vessels. Injuries are frequent causes of hemorrhage into the vitreous, and it may be so extensive as to fill the entire vitreous chamber. Not infrequently the clot will be so dense that no fundus reflex can be obtained. By oblique illumination the dark-red color of the blood can be seen. Spontaneous hemorrhage into the vitreous, associated with retinal hemorrhage, is sometimes seen, especially in young men. Hutchinson supposed gout to be a factor at times, while Eales attributes the condition to constipation and circulatory wrongs. Vision is disturbed according to the amount of the hemorrhage and the absorption following.

*Treatment.*—For functional heart trouble, cactus. In chronic heart disease nitro-glycerine seems to be the remedy



where there is general anemia. *Strophanthus*: The indications for this drug are a weak heart due to muscular debility, or muscular insufficiency of the heart; pulse rapid, with low blood pressure. *Digitalis* should be used in cases of structural heart disease, following the indications for the use of the drug. In gouty cases, *colchicum*. For promoting absorption of the hemorrhage, *jaborandi* and *bryonia*. If constipation is present, *podophyllum* or *podophyllin*. Where there is a specific taint, iodide of potassium, giving it in small doses, gr. j to ij. If there is a hemorrhagic tendency, active in character, *ergot* or *belladonna*; when passive, *hamamelis* or *carbo. veg.*

**BLOOD VESSEL FORMATION IN THE VITREOUS.**—In some cases the ophthalmoscope will reveal a more or less veil-like formation of fine blood vessels, starting from the optic disk

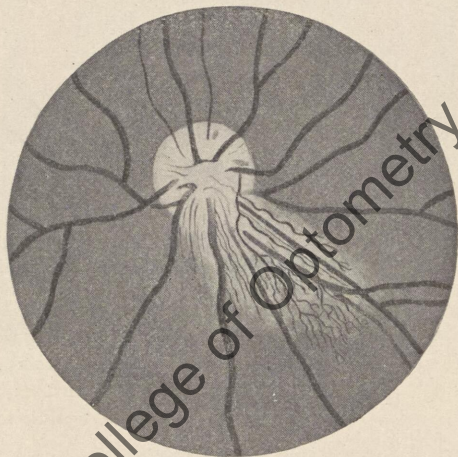


FIG. 71.—Blood-vessels in the vitreous.

and passing forward into the vitreous. These vessels are independent of the retinal vessels. When this picture is present it is good evidence of a previous hemorrhage or inflammatory change in the vitreous. Occasionally purulent

infiltration or specific disease of the globe are supposed to cause it. The vessels may be few or numerous.

FOREIGN BODIES IN THE VITREOUS.—This condition has already been given.

ENTOZOA (*Cysticercus Cellulosæ*).—This parasite is not often seen in this country. It is the scolex of *tenia solium*. The patient may be the possessor of a tape worm, and some of the joints getting into the stomach are digested, freeing the eggs, or they may be introduced into the stomach in the drinking water, or food. The embryos developing, penetrate the walls of the stomach and enter the blood vessels. They are carried by the circulation and may reach the eye, boring through the tissues and develop as cysticerci. They may develop beneath the retina, producing detachment of this membrane, and eventually perforate the retina, getting into the vitreous. Supposed at times that it enters the vitreous directly from the choroidal vessels.

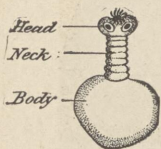


FIG. 72.—*Cysticercus*, head and neck extended.—*Fick*.

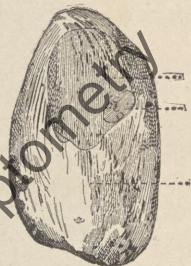


FIG. 73.—*Cysticercus*, head and neck withdrawn, lying in the external vesicle.—*Fick*.

*Treatment*.—Operative, for if not removed an irido-cyclitis results which eventually destroys the eye, necessitating an enucleation. (See Operations).

FILARIA SANGUINIS HOMINIS (*Filaria Oculi Hominis*).—This parasite is extremely rare, probably but one authentic case being recorded.





FIG. 74.

Ophthalmoscopic view of living *Cysticercus* in the Vitreous.

(Fick)

DETACHMENT OF THE VITREOUS.—This condition may result from intra-ocular growths, hemorrhage, traumatism, choroiditis, staphyloma or high degrees of myopia. Detachment of the retina may follow, and produce blindness. Opacities are generally present in detachment of the vitreous. In atrophied eyeballs there will sometimes be seen connective tissue bands extending from the optic disk to the posterior surface of the lens.

PERSISTENT HYALOID ARTERY.—The hyaloid artery usually commences to degenerate at the fifth or sixth month of gestation, but in some instances partial obliteration only occurs. It may persist as a strand passing from the disk to the posterior surface of the lens, or simply as a vestige projecting from the disk. This partial degeneration is probably an important factor in producing posterior polar cataract.



## CHAPTER XIII.

### DISEASES OF THE RETINA.

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ANATOMY.—The retina constitutes the third or inner coat of the eyeball, and is not only the receptive portion for visual stimulation, but also may be considered as a peripheral portion of the brain. This layer is called the nervous tunic as it contains the expansion of the optic nerve, which is specialized for light sensations.

Embryologically the retina is ectodermic in origin. The retina is divisible into two portions, the posterior (*pars optica retinae*) extends from the optic nerve head to the ora serrata, covering about two thirds of the ball, and is the active visual portion of the retina. The anterior portion extends from the ora serrata over the posterior surface of the ciliary body and iris to the anterior pupillary margin and is designated respectively a *pars ciliaris* and *pars interna retinae*.

The posterior portion of the retina is composed of two layers, inner and outer, corresponding to the inner and outer layers of the optic vesicle. The inner lamina comprises all the retinal layers excepting the pigment layer which forms the outer lamina.

The retina resembles other portions of the central nervous system in consisting of nervous and sustentacular elements. The latter, the long fibers of Muller, comprise the framework which is arranged in columnar segments forming the external and internal limiting membranes.

*Pigment Layer.*—The usual arrangement of the pigment layer is that of hexagonal cells, although exceptions are frequent. The nucleus is not pigmented.

*Neuro-Epithelial Layer.*—This consists of the layers of rods and cones, as well as the external nuclear layer. This represents the visual cells, and for convenience is usually described as two distinct layers. The visual purple (*rhodopsin*) is located in the rods, and its distribution is uniform

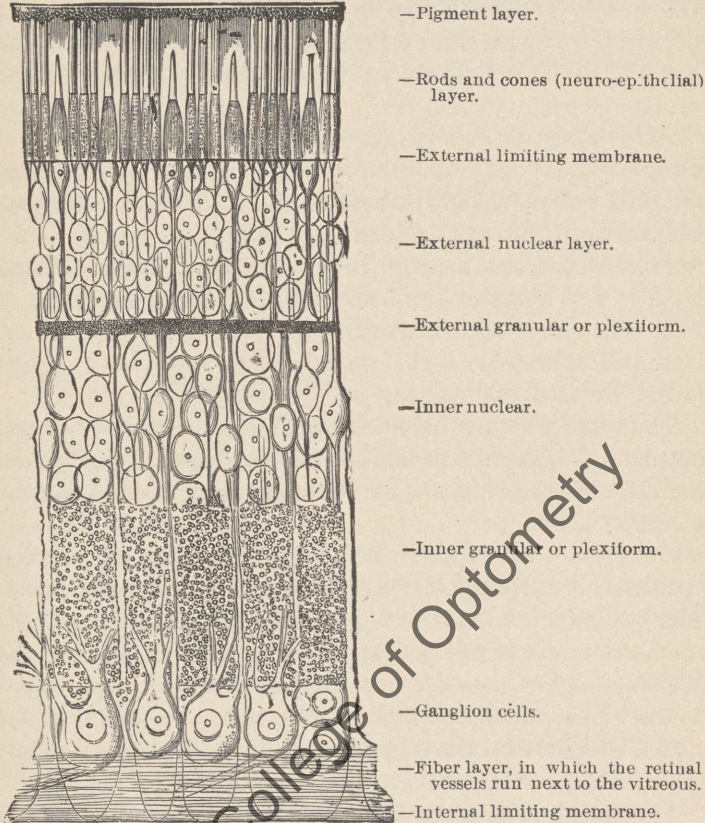


FIG. 75.—Diagrammatic Section of the Retina, exclusive of the macula.—Yeo.

throughout the external segment of rods. At the *fovea centralis* the color differs from the balance of the retina on account of the absence of the rods. The cones do not contain



visual purple, and they practically constitute the visual cell element in the macular region, while in the fovea no rods are found.

*The External Plexiform or Outer Reticular Layer.*—This is the first division of the cerebral layer of the retina. As usually observed it has the appearance of a narrow granular band, but with careful preparation and magnification it is found to be a delicate tissue framework containing the visual cell terminations, etc.

*Inner Nuclear Layer* (Bipolar Nerve Cells).—This is a complex layer and appears to be transitional in structure, not only receiving light stimulation, but also transmitting the impulses through the ganglion cells.

*Inner Plexiform Layer* (Inner Reticular Layer).—This layer is also complex in its construction, being composed of fine reticulated fibers crossed by the long fibers of Muller. Terminal processes of the visual cells, and the ganglion layers, are also included.

The inner reticular layer is divided into different substrata, depending upon the distribution of the descending fibrils of the inner nuclear layer, and the ascending fibrils from the ganglion layer.

*Ganglion Cell Layer.*—This layer, composed of nervous elements, is intimately related with the optic nerve fibers. The ganglion cells are arranged closely together in a single row in the most of the retinal structure, but approaching the macular region they are more closely arranged, assuming a double layer in the vicinity of the macula. In the macular region proper there are eight or ten rows. Towards the periphery of the retina the cells become scattered.

The ganglion cells are divisible into two primary types; those in which the processes are included within a certain substrata and those distributed throughout the entire layer. The first division is again divided into those found in but one, and those found in two or more substrata. This subdivision is again divided into large, medium and small cells.

*Optic Nerve Fiber Layer.*—The nerve fibers from the ganglion cells, in the form of axis cylinder processes, and which compose the most of this layer, converge towards the entrance of the optic nerve, and continue toward the visual centers through the optic nerve and tract. In some cases the medullary sheath or "white matter of Schwann" invests these axis cylinders before passing through the lamina cribrosa, giving the appearance known as "opaque nerve fiber" with the ophthalmoscope.

The retinal nerve cells are supported by the neuroglia, ectodermic in origin, which assumes two forms, radial fibers of Muller and the "spider cells." The fibers of Muller, besides being distributed throughout the retina, constitute what is usually described as the internal limiting membrane.

The spider cells, or stellate neuroglia, appear to be limited to the nerve fiber layer and its continuation in the optic nerve.

*The Macular Region.*—The *macula lutea*, or *yellow spot*, occupies a position in the globe corresponding to the posterior pole of the visual axis. This is a specialized area, surrounding the *fovea centralis*, which is the direct sensitive point of distinct vision.

The *macula lutea*, by an ophthalmoscopic examination, usually appears oval, but is nearly circular, and is situated to the temporal side of the optic papilla, and approximately corresponds to the horizontal axis of the eye.

The *fovea centralis* is located in the center of the *macula lutea*, and on account of the thinness of the retina at this location appears, by ophthalmoscopic examination, as a brownish-red point. It is not always easy to distinguish this region even in a normal fundus, as there may be excessive pigmentation of the retina masking the characteristic picture.

In the *fovea*, the rods being absent, there is no visual purple. The ganglion cells are more numerous in this region than in any other portion of the retina.



The ora serrata marks the anterior limit of the visual retina elements, and at this point all of the specialized structures disappear excepting the pigment layer. The *pars ciliaris* and *pars iridica*, which constitutes the anterior segment of the retina, are made up of a double layer of cells.

The *outer lamina* is composed of pigmented cells continuous with the pigment layer of the visual retina, but the cells are less developed.

The *inner lamina* comprises a single row of columnar cells, which are not pigmented in the ciliary region, but in the *iridian* portion are abundantly supplied with pigment.

The optic papilla causes another variation in the retinal field. The *optic entrance* or *optic papilla* is the location towards which the retinal axis cylinders converge to form the optic nerve, which passes from the eyeball to the brain. The surface of the normal papilla, as seen with the ophthalmoscope, varies in appearance, much depending upon the color perception of the observer, from a yellowish to a bluish or white color.

The central retinal vessels emerge from near the center of the papilla, and dividing pass over the surface to reach the fiber layer of the retina. The central portion of the disk is usually depressed, and is called the *physiological cup*. The margin of the disk, on account of the thickness of the nerve fiber bundles, is generally more elevated than the surrounding area. From this condition arises the name "papilla." The position of the cup is usually central, occupying about two-thirds of the disk. The extent and abruptness of the sides of the excavation vary considerably within physiological limits.

*Retinal Blood Vessels.*—The central retinal artery and its associated vein constitute the principal retinal circulation. Near the optic entrance there is the only communication with the ciliary vessels, as a rule. Fifteen to twenty millimeters, 10-16 in. to 13-16 in., back, and a little below and externally, the central artery and vein enter the optic nerve

obliquely, and passing to the axial portion maintain this position as far as the papilla. Here division usually occurs into the superior and inferior divisions, which pass upwards and downwards. Subdivisions occur from these branches, so that the entire retina is supplied. Anastomosis of the retinal vessels does not occur. The retinal veins accompany the retinal arteries very closely, and are usually larger and the color darker.

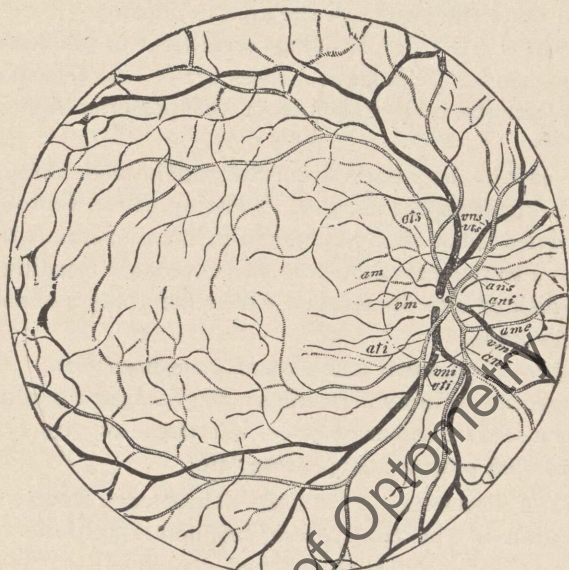


FIG. 76.—Diagram of Retinal Vessels—arteries light, veins dark. *ans, vns*, superior nasal vessels; *ats, vts*, superior temporal vessels; *ani, vni*, inferior nasal vessels; *ati, vti*, inferior temporal vessels; *ame, vme*, median vessels; *am, vm*, macular vessels.—Fox and Gould.

**Lymphatics.**—The lymphatic circulation of the retina is maintained by the perivascular lymph channels surrounding the veins and capillaries.

**CONGENITAL ANOMALIES.**—Coloboma of the retina is sometimes seen, and also cysts, as congenital conditions.



*Opaque Nerve Fiber.*—This is not an uncommon condition. The amount of medullary sheath varies from a small spot, which may be distinct from the disk, to a considerable amount, spreading, as a rule, from the upper or lower portions of the disk over extensive surfaces, the edges generally being feathery. (See colored plate.) With the ophthalmoscope the appearance is that of a white patch, the retinal vessels being obscured in part by the fibers. Visual defects depend upon the extent of the area implicated.

*Retinal Vessels.*—Anomalous conditions of the vessels are not uncommon. In some few cases the central retinal artery is supplemental by a branch from the posterior ciliary arteries.

The exit of the vessels from the papilla is variable, sometimes being from the margin. Twisting of the veins around the arteries is not uncommon, and in some instances the vessels seem to push forward into the vitreous, returning again to the disk or near its margin, where they may assume their normal course.

Congenital pigment patches are sometimes seen.

Congenital retinitis pigmentosa, or glioma of the retina occurs in a small number of cases, but does not vary from the same morbid processes appearing later.

**SENILE RETINAL CHANGES.** These vary from a slight diminution in the transparent, brilliant appearance of the normal adult eye, to such marked changes that it is almost impossible to distinguish them from extensive retinal or choroidal diseases. A mottled appearance is sometimes produced by small, grayish spots.

Colloid excrescences of the choroidal vitreous lamina are occasionally seen. The retinal elements become disorganized, as these points penetrate the tissue. When they become detached from the choroid they stray into the retina, and may form nodules elevated above the retina. The ophthalmoscopic appearance is that of whitish-yellow, round, slightly protruding spots, generally with a pigment border. They

are most numerous at the periphery. Small black spots are scattered throughout the morbid field. Central vision may be normally acute in this condition.

The disease is differentiated from disseminated choroiditis by the fact of being peripherally located, small, round, symmetrically grouped elevations, and with a pigment border. Coalescence does not occur. In disseminated choroiditis the spots are large, irregular depressions, and irregularly arranged about the posterior pole of the globe. In cases of long standing, scattered pigment patches will be seen and the spots are confluent.

A change which may be mistaken for albuminuric retinitis, is where there are crystals of carbonate of lime, and some also claim cholesterine, found in the retina. These crystals may involve the entire retina, but usually are not numerous in the posterior portion. They may however be grouped around the macula, and the appearance is that of small, yellowish-white spots, sometimes combined, forming comparatively large plaques. The color of the spots may change to a pale rose. The papilla may be pale. Peripheral vision may not be much affected, but central vision is diminished.

Another form is where coalescence of the spots just described forms a pigment-bordered, yellowish-white ring around the papilla. This may be mistaken for a posterior staphyloma. Visual acuity in this condition may not be affected. It should be remembered that vision is probably always reduced in proportion to the age, even when no marked senile changes are present.

ACQUIRED ANOMALIES OF THE RETINAL VESSELS.—In new connective tissue formation in the retina or vitreous, blood vessels are often seen running from the retinal vessels. They usually are formed after an inflammatory action, and are almost positive proof of previous retinal or vitreous hemorrhages. The adventitious vessels (*vasa præretinalia neoplastica*) although permanent in persistency are some-



times movable and are most frequently seen in old persons, but two cases from my records were aged 25 and 28 respectively. The one gave the history of a blow on the head; there was rupture of the choroid and the connective tissues encroached on the papilla. Light perception was lost. The second case fell from a step ladder, striking the head against a chair. The connective tissue did not reach quite to the lower edge of the papilla, and the vision was impaired only for the upper half of objects. Other factors producing new vessel formation are diabetes, syphilis, and arterial sclerosis. Visual disturbances are proportionate to the pathological condition. Seldom, if ever, will remedial measures produce any improvement after the morbid process is established.

RETINAL ANEURISMS.—Not often seen. A simple form is where but one dilatation is found. Usually they are of small size. Miliary aneurisms are found on the smaller arteries and are multiple. This form appears, from reports, to be associated with cerebral miliary aneurisms.

ARTERIO-VENOUS ANEURISMS.—As a rule result from traumatism. Communications between the larger arteries and veins being established. Congenital cases of this form have also been reported. These aneurisms are termed spurious.

There is no difficulty in making a diagnosis of aneurisms with the ophthalmoscope. Vision will depend upon the location and extent of the dilatation. Treatment has no effect.

PHLEBECTASIA RETINÆ (Dilatation of the Retinal Veins).—Tortuous veins are common, but phlebectasia is seldom seen. The varicosities may assume different shapes, which will designate the type.

PERIVASCULITIS OF THE RETINAL VESSELS.—As a rule this is only a symptom in retinal diseases, but may occur independently. The appearance is striking. The arteries may appear as white, or yellowish-white bands, and the

veins often show a white border. Infiltration of round cells into the adventitia and perivascular lymph spaces occurs, and hemorrhage or thrombosis may result. Unless the retinal vessels are affected, disturbance of vision is usually slight.

Treatment should be restorative, but if distinct morbid processes are present in the retina little can be accomplished.

ARTERIO-SCLEROSIS.—Usually the result of old age, and a general arterial sclerosis. The cerebral arteries are often similarly affected. The fundus appearance varies, depending upon the time of observation. As a rule the vessels are tortuous and diminished in size with white streaks along the margins. Arterial pulsation is frequent. In chronic and severe cases the larger vessels appear as white bands, and the smaller ones may be obliterated. Aneurisms are often present. The early stages of degeneration are found associated with multiple hemorrhages. Visual disturbances vary through all stages from slight haziness to merely light perception. Connective tissue formation and degeneration, producing thickened and rigid walls, constitute the changes in the retinal vessels. The venous walls may be thickened. Early recognition of this disease may prevent more serious lesions by insisting upon a quiet life, both mentally and physically.

HYPEREMIA OF THE RETINA.—When independent of any inflammatory condition, it is not always easy to determine this. The optic disk is more or less reddened, but the margin is distinct in the arterial or active form. Increased vascularity is shown by more tortuous vessels, and the small arteries being more distinctly seen than normally. Arterial pulsation is sometimes present.

In venous or passive hyperemia the disk is reddened and small vessels, ordinarily invisible, can be seen over it, and the margin of the disk is not normally distinct. The veins are dilated and tortuous, while the arteries are normal, un-



less they are obstructed, when they may be smaller and straighter than normal.

Hyperemia often results from other eye diseases or constitutional disorders.

*Causes.*—Arterial hyperemia may be due to accommodative or muscular eye-strain, working with an insufficient light, or exposure to intense light and heat, as glass blowers, puddlers, etc.; during the inflammatory action of fevers; disease of the iris, choroid, or of the deeper corneal tissues; early stages of retinitis; plethora, etc., may be factors. This form has also been described in conjunction with general hyperemia.

Venous hyperemia may depend upon obstructed circulation in the eye, as in glaucoma, or the obstruction may be in the orbit or brain, when choked disk will follow. Meningeal congestion, intra-cranial tumors, or any impediment of the venous circulation may cause it.

*Treatment.*—If the hyperemia is due to refractive errors, correcting lenses should be given. If muscular imbalance is the cause, such measures as will afford relief should be employed. Rest is an important factor in many cases, and a weak mydriatic may be necessary. Constitutional wrongs should be appropriately treated. When the hyperemia is of the active type, aconite, veratrum, or gelsemium may be indicated. The passive form will usually call for ergot or belladonna. The saline cathartics will afford relief when indicated. General indications for drugs must be looked for.

**ANEMIA OF THE RETINA.**—This is a symptom of some constitutional disturbance or of local pressure. The most marked type is seen in embolism of the central retinal artery. In progressive atrophy of the optic nerve anemia is also marked, being the result of compression of the vessels. Cerebral anemia, syncope, and sometimes general anemia may also cause retinal anemia. Vaso-motor spasm may cause contraction of the retinal arteries in migraine. In

these cases temporary partial (hemianopic) or complete blindness may occur. According to Priestley Smith, if the blindness passes from above downwards, the retinal circulation is obstructed, but when it is lateral the visual centers of the cortex are probably affected. Excessive arterial tension may also be responsible for the retinal disturbances. The arteries are constricted and at times show pulsation. The veins are dark and the disk pallid. If the condition continues optic atrophy may follow.

Ischemia of the retina is a term used to designate a severe type of anemia. Embolism of the retinal artery or compression of the artery by disease or morbid growth may produce this condition. Sudden total blindness often occurs in these cases. Ischemia has also been noted by Graefe in the last stages of cholera. Whooping-cough, erysipelas, cinchonism, and toxic doses of salicylic acid, have also been given as factors.

*Prognosis.*—Unfavorable, as blindness usually results.

*Treatment.*—Remedies which will stimulate the circulation, as nux vomica, nitro-glycerine, digitalis, or strophanthus, as indicated. Nitrite of amyl may afford relief in spasm of the retinal artery and cerebral anemia. The general conditions requiring treatment should be regarded. Corneal paracentesis and iridectomy have failed to produce beneficial results.

RETINAL HYPERESTHESIA (Irritation of the Retina).—In this the prominent symptoms are photophobia, lachrymation, neuralgic pain referred to the eye or surrounding tissues, often blepharospasm and inability to use the eyes for any length of time. Ophthalmoscopic changes are frequently absent, but the appearances described under hyperemia are often present. Besides the general reddened appearance of the papilla, the nasal margin is most likely to be the most hazy. Situation of the retinal fibers surrounding the disk, and often inability to sharply define the details of the fundus may be present.



*Causes.*—In neurotic and hysterical patients, ametropia or muscular asthenopia are often responsible. Also often found following typhoidal types of fever, the exanthemata, chronic headache, sexual abuses, and neuralgia. Renal disturbances also seem to originate some cases, and an excess of uric acid may be a factor, and DeSchweinitz reports oxaluria. Morbid conditions of the upper respiratory tract, as chronic rhinitis, hyperesthetic areas in the nose or pharynx, may be either a cause or a complication in these cases. The probability of irritation of the retina, sometimes preceding an organic nerve lesion, has been stated by Loring.

*Prognosis.*—Guarded, regarding the time required to effect a cure.

*Treatment.*—Refractive errors and muscular anomalies should be corrected, but in many cases the relief will be but slight. Improvement of the general health is important. When the patient is neurotic this must be overcome. The naso-pharynx should be inspected and the urine carefully examined. The advice sometimes given to have the patient stay in a darkened room will aggravate instead of diminish the trouble, as a rule. Exercise in the open air, with protection of the eyes with moderately tinted glasses will be better.

Belladonna will relieve in many cases; jaborandi has proven of service in cases with a moderate amount of spasm of the muscles of accommodation. Ignatia in females with menstrual wrongs has proven more beneficial than nux vomica. However, either of these drugs at times increases the irritation, as they may at times also aggravate irritation of the nervous structures in other parts of the body.

*METAMORPHOPSIA.*—This visual anomaly results from displacement of the retinal elements through exudation, usually in the choroid. If parallel lines are observed, there will be distortion (metamorphopsia). If the central lines seem bent towards the point of fixation there is also a diminution in the size of objects, *micropsia*; this results from

separation of the retinal elements and shows a recent lesion. If the lines bend outwards, *macropsia*, in which shrinking or atrophy is present, and there is overlapping of the retinal elements through the shrinking or atrophy, and the lesion is an old one. The card on which the lines are drawn may have to be rotated in different directions to get the effect.

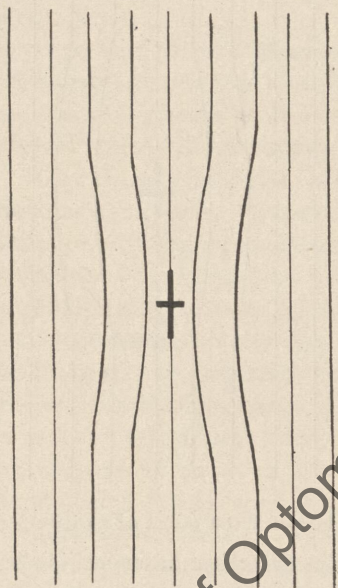


FIG. 77.—Lines bowed towards the point of fixation—micropsia. *Herry.*

ASTHENOPIA OF THE RETINA.—(Neurasthenic Asthenopia, Retinal Anesthesia).—This comes properly under the heading of an amblyopia. It is very often an associated symptom of neuritis. Frequently in asthenopia of the retina there is also hyperesthesia and irritation.

The usual symptoms complained of are inability to use the eyes for any length of time for close work; impaired vision; wavering and dimness of objects; muscular weakness; pain



in the eye and head, often continuing for some time after ceasing work ; the accommodative power may be diminished and intolerance of light may also be complained of.

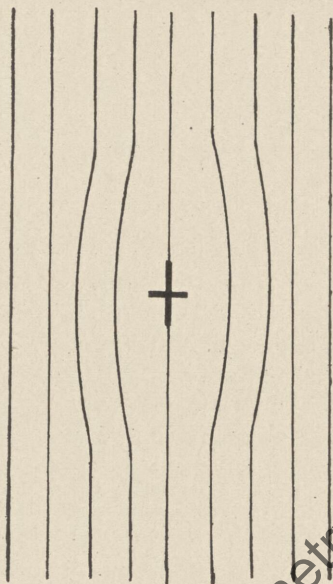


FIG. 78.—Lines bowed from point of fixation—macropsia.—Berry.

The chief characteristic however, is the peculiar contraction of the field of vision. At the beginning of the examination, the normal limits may be obtained, but contraction both above and below the horizontal meridian becomes marked as the examination progresses. If the patient is allowed to rest, and on commencing again the examination is reversed, it will be found that the second field is reversed as regards the contracted and expanded portions. The latter is called by Wilbrand the *counter field*. The visual color fields show nearly similar conditions as that for white.

Retinal exhaustion from any cause will present the same characteristic of the visual field.

The majority of cases are women, generally anemic, chlorotic, neurotic, or hysterical. That disturbances of the reproductive organs may be a factor should be remembered, as distinct cases are seen in the male. About the age of puberty this retinal anomaly is not infrequently noted in both sexes. There is often marked general debility of the muscular and nervous systems.

*Prognosis.*—Favorable.

*Treatment.*—Improvement of the muscular, nervous and mental health. Freedom from mental and physical fatigue, but a moderate amount of open-air exercise should be insisted upon. Change of scene will sometimes have a marked beneficial effect. A weak mydriatic will often relieve the more marked asthenopic symptoms. Correction of refractive and muscular anomalies, although important adjuncts, will not perceptibly mitigate the symptoms. Tinted glasses should not be worn excepting in very bright sun light, as the eyes will become accustomed to the modified light, and the asthenopic condition will be increased instead of diminished. In chlorotic or anemic cases, with the skin tawny, pallid, and waxy; mucous membranes pale; tongue broad, pale and uncoated, cuprum in doses of grtt.  $\text{ss}$  to  $\text{ss}$  four times a day will be indicated. Nux vomica or ignatia when the retina is not markedly hyperemic. Aburnum, cimicifuga, pulsatilla, or jaborandi in menstrual difficulties which are amenable to treatment. Electricity has been recommended in these cases, but is of doubtful benefit. Relapses are frequent.

RETINITIS.—Under the term retinitis are classified all inflammatory conditions of the retina. Retinitis, when the morbid process depends upon systemic wrongs, is primary, but if it is the result of extension from adjoining tissues, as the choroid, iris, etc., it is secondary.

Retinitis may be circumscribed or diffuse. Pathologically it is parenchymatous and serous. The disease credited as the cause designates the clinical type.



*Symptoms.*—In the majority of cases the usual line of objective symptoms predominating are :

1. *Loss of Transparency.*—There may be a more or less diffuse, hazy appearance of the retina ; circumscribed swellings or opacities ; or whitish streaks, usually accompanying the larger vessels.

2. *Exudation.*—This is a later condition. The areas may appear as whitish, yellowish or bluish-gray spots, distinct or confluent. They differ from choroidal atrophy in their situation, absence of choroidal pigment masses, and in not being so markedly white. They may be confined to the macular region, or distributed in any portion of the retina.

3. *Tortuosity and Change in Caliber of the Vessels.*—The arteries may be slightly changed, but the smaller vessels are frequently very tortuous. The veins are abnormally dark, and they may be either lengthened or the outlines excessively irregular. The course of the retinal vessels often appears irregular, as they traverse thickened areas, or become indistinct on account of the infiltrated tumid tissue.

Numerous vessels which are invisible in the normal eye becoming injected, can be distinguished passing from the papilla as fine lines. Pressure will usually produce pulsation of the vessels.

4. *Hemorrhages.*—Hemorrhages may occur without any inflammatory action in the retina, so they are not diagnostic of retinitis, unless other evidences are present. They may be either in the nerve fiber layer or the deeper portions. Hemorrhages in the nerve fiber or superficial layer are generally "flame shaped," the edges being feathery, but if in the deeper layer they are rounder in form and the margins clear.

5. *Papillary Changes.*—The changes in the nerve-head vary from a slight to a marked redness, indistinctness of the margin on account of the swollen retinal fibers, and possibly later a true optic neuritis. Following a severe retinitis, atrophy of the nerve nearly always occurs.

6. *Pigmentation*.—Black pigment spots will locate old retinal hemorrhages, but are not conclusive evidences of a previous retinitis. The method of distinguishing between choroidal and retinal pigment is usually made by the fact that if the retinal vessels pass over the pigment and apparently in a plane anteriorly, the pigment is assumed to be in the choroid; if the retinal vessels are covered by the pigment, or appear to be posterior to the mass it is a retinal pigmentation.

7. *Retinal Atrophy*.—This may result from an old hemorrhage or inflammation. If a white area of sclera is exposed, it indicates that all the layers of the retina and choroid are involved, (atrophic choroido-retinitis). If the color of the spot is yellowish or whitish, the superficial retinal layers alone are implicated. Following a retinitis, diminution of the vessels occurs, and white borders are frequently shown.

Besides these ophthalmoscopic changes there are subjective symptoms as :

1. *Change in Visual Acuity*.—This depends upon the severity and location of the inflammation, and there will be a proportionate impairment of central vision. Occasionally visual acuity is increased during the formative stages of simple retinitis, but this is more frequently seen in retinal irritation than in inflammatory.

2. *Change in the Visual Field*.—The field of vision may be irregularly or concentrically contracted. Scotomata are often present in the center of the field.

3. *Distortion of Vision*.—Two forms are observed, either a diminution in size of objects (micropsia), or a variation in their form (metamorphopsia).

4. *Pain and Photophobia*.—Pain with one exception, is seldom present in any type of retinal inflammation. A sensation of discomfort may be complained of. Photophobia is not a diagnostic feature. It may or may not be present, but when it is, the use of tinted lenses will often afford relief.

*Diagnosis*.—The ophthalmoscope will show loss of trans-



parency, circumscribed opacities or swellings, and sometime whitish streaks accompanying the larger vessels. These constitute the only definite features. Pigmentary exudation, hemorrhages and atrophy, when present, are corroborative symptoms aiding in deciding the clinical type, but alone, are not diagnostic evidences of retinal inflammation.

*Objective Symptoms.*—An important aid in the diagnosis is carefully noting the acuity of vision with varying illumination. If the visual acuity is diminished out of proportion to the intensity of light, it should be considered as an important sign of retinal disturbance. This, in connection with the changes already noted in the field, should make the diagnosis fairly certain.

*Course Complications.*—Retinitis may be *acute* or *chronic*, and its duration short or prolonged. Vitreous changes (vitreous opacities) are common when the inflammatory action invades both the retina and choroid at the same time, and as the papilla is usually involved, atrophy generally follows in long standing cases, (*retinitic atrophy*).

*Prognosis.*—This depends upon the extent of the lesion, whether situated in the superficial or deeper layers, location as regards the point of distinct vision, and what secondary changes may occur in the papilla, as well as the exciting cause. Other things being equal, syphilitic retinitis promises the best results. Although in many instances the outcome is favorable, it is safest to give a guarded prognosis, unless the chances are unqualifiedly bad when the worst must be expected.

RETINITIS SIMPLEX (Serosus, Diffuse, Edema of the Retina).—The nerve fiber and ganglion layer especially are infiltrated, resulting in opacity and edema, with venous hyperemia. The opacity may be scarcely perceptible, or it may be a marked grayish-white, most prominent surrounding the papilla, and obscuring the margin more or less. The density of the opacity lessens as it passes into the adjacent retina. The disk is not swollen, but is obscured by

the edema, or if this is not decided it will be red and the margin indistinct on account of the injected capillaries.

The arteries are seldom much changed unless there is compression. The veins are distended, tortuous, darker than normal and often partly covered by the edematous tissue. It is seldom that hemorrhages occur, and exudation in the region of the macula is infrequent.

Vision is defective, central being dim or misty, and the peripheral being contracted.

*Causes.*—Excessive light and heat; ametropia with constant use of the eyes by defective light; exposure; or this process may be the formative stage of more serious types of retinitis. In some cases no cause can be assigned.

*Prognosis.*—This is the least destructive form, but some visual disturbances are almost sure to be permanent.

*Treatment.*—Rest is one of the important factors. In the acute type, especially during the early stages, a brisk cathartic should be given. Aconite, veratrum, ergot, pulsatilla, jaborandi, iodide of potassium, red iodide of mercury, chionanthus, gelsemium, apocynum, apis, etc., should be given according to the indications for these drugs.

**PARENCHYMATOUS RETINITIS.**—This includes any retinitis, where, in addition to the changes given under simple retinitis, cellular infiltration and structural changes are present which will eventually cause atrophy.

Gray or yellowish exudative areas, either scattered over the fundus, or confined to the macular region, are seen. Small hemorrhages are usually present, and often the vessels are implicated.

*Diagnosis.*—The descriptions given will be recognized by an ophthalmoscopic examination. In some cases there may be a dull, deep seated, aching pain. Disturbance of vision will depend upon the extent of the morbid process, varying from a slight mistiness to nearly total loss of sight. The visual field is contracted, scotomas are present, and the deviation in the shape of objects is pronounced.



The disease may be confined to the superficial or deeper layers, but all may be affected and include even the choroid. It may also be diffuse or limited in area.

*Causes.*—Usually systemic diseases, uterine disturbances, intracranial disease, or it may follow diseases of other structures of the eye.

*Prognosis.*—Always doubtful, as atrophy of the nervous elements will result in the majority of cases through compression. Occasionally absorption may occur, but seldom without leaving irremediable changes.

*Treatment.*—This will depend upon the cause, and will, with the exception of some of the clinical types, not vary much from that of simple retinitis.

The two forms described are the basis of most of the clinical divisions.

**SYPHILITIC RETINITIS.**—There are a number of subdivisions under this heading :

**SYPHILITIC CHORIO-RETINITIS** (Diffuse Syphilitic Chorio-Retinitis.—The fine points, or dust-like opacities in the posterior portion of the vitreous, are the most characteristic features of the disease. They may be stationary or movable, and may appear to be uniformly distributed, or be in groups or rows. In time the most of them may disappear. The papilla and its surrounding tissues, especially on the nasal side, are usually indistinct, on account of these opacities. The disk itself is often hyperemic, and as seen through the opacities may appear swollen. Loss of retinal transparency is marked ; circumscribed yellowish or whitish spots of pigment-bordered exudation, crossed by the retinal vessels, may be seen throughout the fundus, being especially numerous in the macular region, as a rule, where they appear whitish or gray, and sometimes coalesce.

Iritis may be a complication in a small per cent. of cases. In a few instances the iritis has preceded the chorio-retinitis. Vision is always reduced, and the light sense so much diminished as to simulate night blindness. In some cases there

will be isolated spots of sensitive retina, producing what is called reticulated vision (*visus reticulatus*). Dancing points and circles (*photopsies*) are generally noticed. *Microopsia* and *metamorphopsia* are usually present, as well as diminished accommodative action.

The disease is insidious, as a rule, and also markedly chronic. Relapses usually occur. The disease generally makes its appearance two or three years after the initial lesion.

*Diagnosis.*—The description already given, together with the history of the patient, should make the diagnosis easy.

It is important in making an ophthalmoscopic examination to use a very weak illumination, as with a strong light the dust-like opacities are often invisible.

DISSEMINATED AND CENTRAL, CIRCUMSCRIBED SYPHILITIC CHORIO-RETINITIS.—Only a few cases have been reported. Schobl states that it appears in younger subjects than the form just described.

The papilla is very red and the margin dim in acute cases, the surrounding areas slightly opaque and grayish. The center of the retina is not as indistinct as in the diffuse form. In cases of long standing the papilla is a dirty, yellowish-white.

Marked changes usually occur in the macular region, there being prominent whitish or yellowish-red spots. The blood-vessels appear nearly normal. When the macula is affected, the central visual disturbance is more pronounced than in the diffuse form, but the reverse holds true when the morbid process is outside of the macula. This form appears more amenable to treatment than the first.

DIFFUSE SYPHILITIC RETINITIS.—In this form the disease seems to be confined to the retina.

A grayish opacity surrounds the papilla, and follows especially along the equatorial blood-vessels, where it gradually fades out. Small white spots can often be seen near the macula and periphery. They appear along the vessels, some-



times covering them like small berries. They are round and pink, changing to yellowish-white, and finally to a pure white (Hirschberg). The time of the development of this type is usually from four to six months after infection, but it may occur in congenital syphilis as well.

*Diagnosis and Prognosis.*—Do not vary essentially from that already given.

RELAPSING SYPHILITIC RETINITIS.—This is a very rare form. According to Von Graefe, there is sudden extreme diminution of vision, which disappears in a few days. Relapses are of frequent occurrence. Following the first few attacks, the vision may be quite good during the intervals, but as they recur the visual acuity is much diminished. The ophthalmoscope shows a slight obscuration of the macula, but the papilla is clear. Finally, the macula becomes grayish-yellow or gray, with at times fine white points grouped around it. The dimness may disappear during the remissions of the earlier attacks, but later is permanent. If the disease lasts for years, pigment spots appear in the margin of the macula, which are dissimilar to those seen in pigmentary retinitis or chorio-retinitis.

Central vision is always reduced. The time in which it makes its appearance after inoculation varies, according to different writers. The disease may develop into some of the other forms of syphilitic retinitis.

SYPHILITIC HEMORRHAGIC RETINITIS.—In this type there are numerous hemorrhages over the fundus; the arteries are more or less diminished in size, showing a white dimness in places; veins are broad, tortuous, and very dark; vitreous opacities; papilla red, with distinct outlines and intense constant headache.—Schobl.

SYPHILITIC ARTERITIS OF THE RETINA.—The arteries appear thin and changed into white or grayish streaks, or may entirely disappear. The veins are enlarged and dark-colored. Hemorrhagic emboli are occasionally seen. There are no other ophthalmoscopic signs in many of these cases,

the disease confining itself to the vessels. Visual disturbances may be slight for a long time. Endarteritis usually occurs simultaneously in both the cerebral and retinal arteries. This disease appears to be a late phase of syphilis.

*Course.*—Always chronic, although the onset may be sudden.

*Prognosis.*—Guarded, as even under the most favorable circumstances, relapses are likely to occur. Extensive chorioidal changes, atrophy of the optic disk, or pigmentary degeneration of the retina may follow.

*Treatment.*—The constitutional treatment given under syphilitic iritis will give the best results in this condition.

**PURULENT RETINITIS.**—Purulent retinitis may result from trauma, especially when a foreign body penetrates the eye through the cornea; severe burns of the cornea have also been followed by this disease. It may also result from puerperal septicemia, pyemia, etc.

Schobl summarizes his investigations regarding the connection between traumatic purulent retinitis and traumatic panophthalmitis as follows:

Acute traumatic retinitis is the cause of panophthalmitis most frequently when foreign bodies enter the eye through the cornea without direct injury to the uveal tract. If foreign bodies have penetrated the eye through the sclera, directly injuring the uveal tract, especially the ciliary body, or where the sclera alone is injured, an acute traumatic chorioiditis is more frequently found.

In the chronic form of traumatic purulent retinitis the clinical features, course, prognosis and treatment do not differ from purulent chorioiditis.

When it is the result of systemic diseases, there are small white spots in the macular region and near the disk. These spots are the result of fatty degeneration of the capillaries and infiltration of the retinal fibers. Small hemorrhages are often seen. Both eyes are usually affected.

*Prognosis.*—Usually unfavorable.



*Treatment.*—In the severe forms, destruction of the eye is almost certain. When the result of pyemia, it is an early indication of death. The milder forms may be more favorable, and the treatment will not differ especially from that given under purulent choroiditis.

HEMORRHAGIC RETINITIS.—This term is applied to those cases in which there are numerous hemorrhages in the retina in connection with inflammation.

The ophthalmoscopic examination will show the papilla swollen, and its edges more or less obscured by the opaque infiltration of the adjacent retina. The arteries are small, while the veins are tortuous, dark, and distended. The hemorrhages may be linear, or flame-shaped if superficial, or roundish if in the deeper layers. They may be located in the macular region, around the disk, or scattered over the entire fundus. White spots are sometimes seen after the absorption of the blood, degeneration having taken place, and the resemblance to "renal retinitis" may be marked.

*Causes.*—Is found in cases with diseases of the circulatory system; at the menopause; in suppressed menstruation, as well as many other diseases. In the majority of cases there is rupture of small degenerated blood-vessels; but some cases have been referred to migration of blood corpuscles. Obstruction of the portal circulation sometimes appears to be a factor. Frequently but one eye is affected. Non-inflammatory extravasations may in some cases cause fresh hemorrhages and inflammation through irritation of the retinal fibers.

*Prognosis.*—Unfavorable. Vision is reduced. The hemorrhagic condition may be an ocular manifestation of serious heart or vascular lesions, and may also be the precursor of fatal hemorrhages. In the most favorable cases secondary changes in the retina and optic nerve are frequent, and even glaucoma may follow.

*Treatment.*—Catharsis is preferable to local bleeding, but the use of arterial sedatives will always be indicated. The

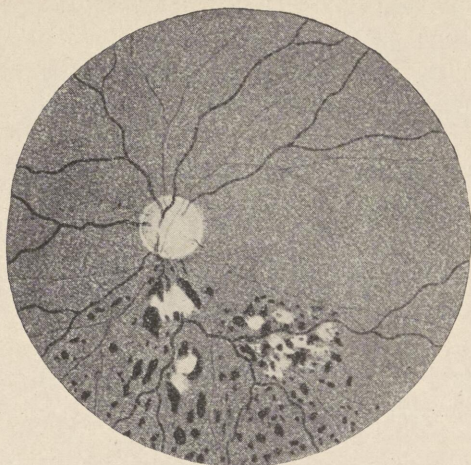


FIG. 79.—Thrombosis of superior temporal vein, with retinal hemorrhages. The white areas are atrophic spots.

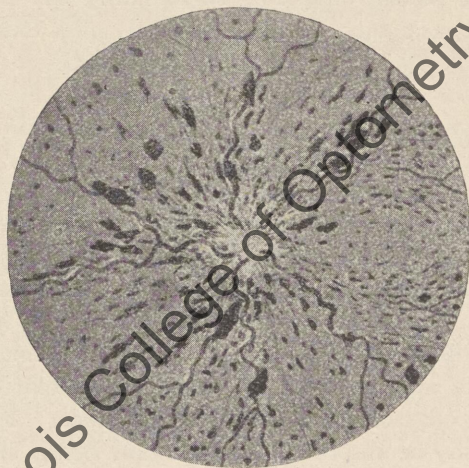


FIG. 80.—Hemorrhagic Retinitis. The entire fundus is affected. The veins are tortuous and distended; the arteries contracted and indistinct.



use of the coal-tar products should always be avoided. Ergot, belladonna, hamamelis, jaborandi or gelsemium may be employed. The portal circulation should be controlled by podophyllin, leptandra virg., chionanthus, or chelidonium.

The eyes should be protected from bright light. Freedom from any physical or mental exertion should be insisted upon.

ALBUMINURIC RETINITIS (Renal, Papillo-Retinitis).—In this type, as the name indicates, the retinitis is due to renal disease.

*Symptoms.*—Variously shaped and arranged white spots make their appearance in close proximity to, or in the macula, and are the first signs of retinitis. As the disease advances, other portions of the retina become invaded, but the macular region will still contain the greatest number of these spots. They may be small and distinctly separated, or may assume a stellate character, surrounding but not invading the fovea, as a rule. In some cases the spots radially placed, partially surround the fovea, like the spokes of a wheel.

White or yellowish-white spots may be seen a little distance from the disk, and may become confluent, forming a zone around the papilla. This has been called the "snow-bank appearance of the retina." The macular spots result from fatty infiltration of the inner ends of the sustaining fibers, while the white spots are due to fatty degeneration of the retinal fiber and granular layers, infiltration of round cells and hypertrophy of the nerve fibers. The hemorrhages may be flame-shaped, round, linear, or minute spots, or sometimes may be quite large and deep-colored, but they have no characteristic clinical appearance. These hemorrhages may be absorbed, their location being shown by the whitish marks. The hemorrhages may be quite numerous and appear to indicate in a measure the severity of the disease.

The blood vessels may pass over the white spots, or may be buried in the tumid retina. A blood vessel may pass under the infiltration, again appearing at a considerable distance. The arteries are usually not much changed from the normal. The veins are dark and often tortuous. The walls of the vessels lose their transparent look in the later stages of the disease.

The papilla and the surrounding tissues may have the appearance of a severe hyperemia, or swelling of the disk may occur, which cannot be distinguished from optic neuritis produced by a brain tumor. A hazy papilla may be present in any condition, but may not be swollen. The characteristic appearance of a retinitis is always present. Often the papillary changes are merged with the surrounding zone of fatty degeneration.

The only subjective symptom is diminution of vision. This varies through all stages to total blindness. An ophthalmoscopic examination will often give the first intimation that the patient has renal disease.

*Types of Disease.*—Two types are usually recognized, but they are often combined. The inflammatory and degenerative form.

In the inflammatory type a neuro-retinitis may be present from the start, or it may commence as a degenerative type, later becoming inflammatory.

The degenerative form starts without inflammatory action, the white spots often being minute, with comparatively normal retina intervening. When hemorrhages are present they are readily discernible, as they are mostly in the nerve fiber layer. When the extravasations are the most noticeable disease feature, it is termed *hemorrhagic*. When the changes are particularly directed to the disk, it is the *neuritic* type.

In all cases of retinal hemorrhages with apparently insignificant points in the macula, renal disease should be suspected and careful, repeated examinations of the urine should



be made. This should always be made a rule in any form of retinitis.

*Causes.*—Most frequently seen in chronic granular kidney, lardaceous disease, and with large white kidney. In pregnancy an albuminuric retinitis is not infrequent. The nephritis of scarlet fever may also produce it. Retinal changes may also result from functional nephritis. Both eyes are affected as a rule.

*Course.*—In the typical type, the disease may be divided into hyperemia of the disk; hemorrhages and opacity of the retina; fatty degenerative stage, and retrograde metamorphosis and atrophy. Although the white spots may subside, they seldom disappear, and the macular changes are quite permanent. The last stage shows a discolored atrophied papilla, contracted vessels with tissue formation along their walls, and pigment changes in the retina.

*Complications.*—Detachment of the retina, extravasation of blood into the vitreous or choroid, embolism, or thrombosis of the vessels, and occasionally glaucoma has been noted.

*Prognosis.*—Unfavorable, excepting in the mildest cases the vision is very much impaired, and a true albuminuria is fatal. An albuminuric retinitis is always a serious symptom. In the albuminuric retinitis of pregnancy, the duration of gestation will be an important factor; it is generally the inflammatory type, and after parturition the inflammatory deposits may be partially absorbed, good vision resulting, unless secondary changes have taken place.

*Diagnosis.*—The descriptions already given under symptoms are characteristic, but all diagnostic aids should be employed.

*Some Diseases Giving Similar Retinal Appearances.*—The neuroretinitis of some cerebral lesions simulates renal retinitis. Somewhat similar retinal appearances are found in diabetes and leucocythemia. Areas of choroidal atrophy show pigment masses, while the white spots of albuminuric

retinitis have none. Opaque nerve fibers pass from the margin of the disk, having fan-shaped margins, and there are no changes in the macula, nor is there retinal edema. The zone, or snow-bank, is circular in form, and macular and retinal changes are present. Small choroidal lesions in the macular region are more scattered, and also more distinctly yellow, and do not often assume a stellate or radial arrangement, and distinct depreciation of vision seldom occurs.

*Treatment.*—The treatment of this disease must be directed to the systemic condition, as local measures are of no avail.

**DIABETIC RETINITIS.**—This always affects both eyes. The disease is not seen as frequently as albuminuric retinitis. Hirschberg divides diabetic retinitis into two principal headings: Central punctate and hemorrhagic.

**TYPICAL DIABETIC RETINITIS (Central Punctate Diabetic Retinitis).**—Either surrounding the macula, or in its vicinity, are numerous small dots and stripes, of an ivory-white color and irregularly arranged. They may partially surround the macula, but have neither the stellate nor radiate figure seen in the albuminuric type. The spots vary in shape from round to linear, and may have serrated margins. Bounded by the macula, papilla, superior and inferior temporal retinal vessels, may be found smaller groups of these spots. Single spots may also be seen towards the periphery. Hemorrhagic points or stripes are scattered between the white dots and macular region. The papilla is not involved; there is no swelling nor diffuse opacity of the retina. Pigment changes are not present and the vitreous is free from opacities.

**HEMORRHAGIC DIABETIC RETINITIS.**—In this form groups of white spots are not discoverable, but extravasations of blood may be found, either as small points near the posterior pole, more peripherally located and larger; large spots occurring suddenly, or as hemorrhagic glaucoma. The propriety of the last division is questionable.

These types of diabetic retinitis may merge or may be complicated with albuminuric retinitis.



Visual defects are frequent in diabetic subjects. Vitreous opacities and hemorrhages are common, especially in the later stages.

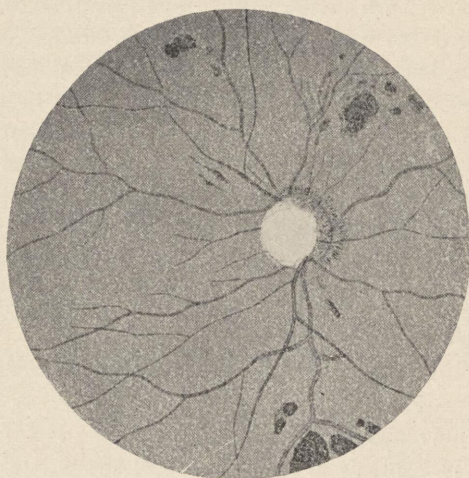


FIG. 81.—Hemorrhagic Glaucoma.

*Prognosis.*—Unfavorable as regards vision, especially in the hemorrhagic form.

*Treatment.*—Constitutional.

**LEUCOCYTHEMIC RETINITIS** (Leukemic Retinitis).—This disease is seldom seen, excepting in splenic leukemia. Both eyes are affected.

Ophthalmoscopic examination shows a pale fundus; this may grade in color from a pale red to almost a lemon yellow. Variable-shaped pale red or orange hemorrhages are seen. In the macular region they are usually small, but approaching the periphery they are larger and more numerous. White spots with red borders are distributed in the hemorrhagic area in typical cases. The arteries appear narrow, light orange or yellow, while the veins are distended, rose-red or orange-red in color.

The disk is slightly if any swollen, but its outlines are

more or less hidden. Papillitis may be present. There may be some opacity of the retina. In some cases a hemorrhagic retinitis may develop which will not differ materially from that of other types. The color of the fundus however, will be characteristic of the disease. An albuminuric retinitis may be present as a complication. An examination of the blood should be made in doubtful cases.

*Prognosis.*—Always unfavorable, unless the splenic condition is early recognized and will yield to treatment.

*Treatment.*—Directed to the constitutional disorder.

**PROLIFERATING RETINITIS (Hyperplastic Hemorrhagic Retinitis, Retinitis Proliferans).**—Often covering considerable of the fundus, the connective tissue formation can be seen as a shining white, bluish, or yellowish-white mass. The disk may be hidden, or portions of the papilla and retina may be seen through well defined spaces in the adventitious tissue. This mass, or membrane, is often undulating and may follow the larger blood-vessels. The blood-vessels are usually beneath the growth, but sometimes appear above it. There may also be new blood-vessels developed in the tissue. Complicating conditions may be detachment of the retina, opacities, and hemorrhages into the vitreous.

*Causes.*—Not definitely known. It is most frequently seen in young persons. Hemorrhages into the retina and vitreous are undoubtedly factors, but often no marked circulatory disturbances are present which would account for the condition. Syphilis has been described as a factor. Traumatism, and in a very few cases oxaluria.

*Prognosis.*—The disease is essentially chronic. Vision is not as defective as would be supposed, and may remain practically stationary, but if complications supervene, blindness may result.

*Treatment.*—Purely empirical unless some systemic disease is present which might cause the condition. Jaborandi, iodide of potassium, or red iodide of mercury might produce improvement.



**STRIATED RETINITIS.**—The characteristic ophthalmoscopic picture is that of light lines or comparatively broad stripes, usually radially arranged with the optic disk as a center. These striations are beneath the retinal vessels, but in front of the retinal pigment layer. They extend toward the periphery and may be bordered with pigment. The color of the lines varies, they may be white, bluish, or yellowish, and generally the edges are sharply defined. There may be slight deviations from the normal in the other retinal appearances, and the vitreous may be hazy. Visual acuity is defective, but the visual field may remain unchanged. Blindness seldom results.

*Course.*—Chronic.

*Causes.*—Not known, and treatment gives no relief.

**CIRCINATE RETINITIS (Fuchs).**—In this type there is a grayish opacity in the macula and vicinity. Separated from the macula by a zone of slightly changed tissue, is a zone of white, unpigmented spots, varying in size. This zone assumes an elliptical form, and is seldom continuous on the nasal and temporal sides. The spots may be slightly elevated, and the retinal vessels pass over them. In severe cases small hemorrhages in the macular region are sometimes seen. The rest of the fundus may be but slightly changed. Visual disturbances develop gradually and increase until there may be only ability to count fingers at three feet.

According to Fuchs, the white spots consist of fibrinous exudation, but DeWecker claims they are a fatty degeneration resulting from hemorrhages. The disease seems to be most frequently seen in women of advanced age.

*Course.*—Exceedingly chronic.

*Prognosis.*—Unfavorable, although complete blindness does not occur. Treatment is of no avail.

**PUNCTATE RETINITIS.**—This name was given by Mooren, but Fuchs has given the most complete description of the disease. Hundreds of small, white, or yellowish, unpigmented spots are seen in the retina. They do not become

confluent and are seldom located in the fovea. There may be no other morbid changes in the fundus.

Central vision is defective, but the field may be normal. Day blindness is often present. The disease is found in young persons, especially the offspring of consanguineous marriage. The disease often comes on early in life, or it may be congenital.

Treatment appears to have little effect.

**PIGMENTARY RETINITIS** (Retinitis Pigmentosa, Pigmentary Degeneration of the Retina).—In this disease there are not only changes in the walls of the blood vessels, but the vessels are contracted; proliferation and degeneration of the sustaining retinal tissue; atrophy of the nervous elements, and deposits of pigment in the retinal substance.

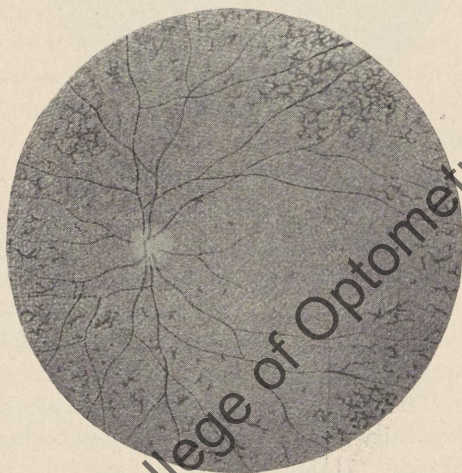


FIG. 82.—Pigmentary Degeneration of the Retina.

Anomalous forms are not infrequent, but in typical cases the ophthalmoscopic appearance is characteristic.

The deposit of pigment resembles bone corpuscles, and through the frequent intersection of the processes, somewhat the appearance of the Haversian canals is given. Beginning toward the periphery, and more numerous on the



temporal side, the pigmentation advances, decreasing in amount towards the posterior pole of the eye. Usually it follows the course of the vessels, and may cover them in spots. Areas lacking in pigment may be seen, and back of this the larger choroidal vessels are distinguishable.

The macular region is usually free from pigmentation for a long time.

The arteries and veins are contracted, and in the later stages may appear as red threads, while the smaller have entirely disappeared. The papilla always presents a dull, dirty color, and may be gray, yellowish, or reddish in tint.

In these cases there is a diminution of peripheral vision, but central vision may remain good for a long time. In some cases the patient can read the finest type, yet be unable to get around unaided. Night blindness is often present, and there is a change in the macular region early in the disease. *Nystagmus* is frequently seen. In a few cases day blindness instead of night blindness is present. The field is generally regularly contracted.

**ANOMALOUS TYPES.**—The macular region may be the seat of pigmentation, when central scotoma will be present. The pigment may be irregularly scattered over the fundus, when clear, shining spots will be seen under the retinal vessels. In some instances there will be the usual line of subjective symptoms, but the characteristic pigmentation will be absent. The appearance of disseminated choroiditis may also be seen.

**Causes.**—The cause of this disease is unknown. Heredity and consanguinity of the parents is an important factor in its development. It appears more frequently in the male than in the female. Deaf mutes, epileptics and imbeciles frequently show this condition, which would indicate that morbid conditions of the nervous system might have an influence. Both eyes are affected.

**Diagnosis.**—In typical cases it is easy. In atypical cases it is sometimes difficult to differentiate. In syphilitic retinal choroiditis the characteristic pigmentation is absent; the

spots do not follow the blood-vessels and are scattered; vitreous opacities are seldom present in pigmentary degeneration, but are in syphilitic retino-choroiditis.

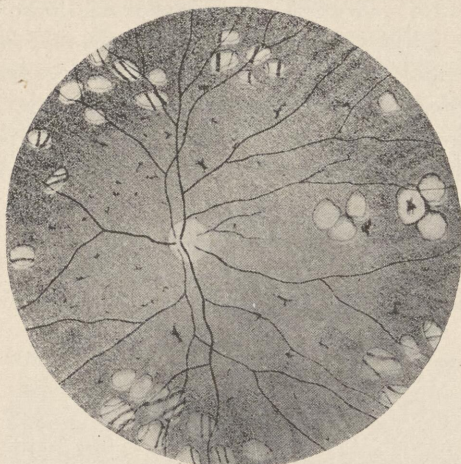


FIG. 83.—Pigmentary Retinal Changes, with Disseminated Choroiditis.

Night blindness, or poor vision in a dim light, should cause a careful examination to be made, using a mydriatic, if necessary, and examining the entire fundus.

*Course.*—Usually a steady contraction of the visual field, resulting eventually in blindness. In some cases the macula may remain free from the disease for a long time, and the process seemingly remain stationary.

*Prognosis.*—Always bad.

*Treatment.*—Attention to the general health, and protection of the eyes from excessive light and fatigue, appear to be all that can be done.

**DETACHMENT OF THE RETINA (Ablatio Retinæ. Amotio Retinæ).**—The cause of idiopathic retinal detachment is not fully understood. There are a number of theories, but none that will explain all cases.



Arlt advocates the secretion or exudation theory, in which sub-retinal fluid from the choroid presses the retina against the vitreous. This may account for cases which develop slowly, and for many cases associated with albuminuric types of retinitis, glioma, sub-retinal cysticercus and sarcoma.

The extravasation or hemorrhagic theory is that sudden extravasations of blood from the choroid occur. This may account for some cases which occur after injuries with loss of vitreous, in hemorrhagic retinitis or glaucoma, and following operations.

The distention or mechanical theory of Von Graefe is that of elongation of the eyeball in the antero-posterior diameter, which might account for some cases with a high degree of myopia.

Leber and Nordenson elaborated the retraction theory, which is that there is shrinking of the vitreous, producing traction on the retina. This is the most generally accepted.

*Symptoms.*—The tension of the eye is diminished in nearly every case; the anterior chamber more or less deepened; if very deep, iridodonesis is sometimes observable. The iris is sluggish in movement and the pupil dilated. In cases of long standing, the iris is discolored and reaction to light is lost, the pupil being largely dilated and posterior synechiæ may be present. Posterior polar cataract often follows.

When the retinal detachment is extensive, a gray reflex may sometimes be distinguished with the unaided eye. Symptoms of the so-called *amaurotic cat's eye* are sometimes seen in these cases, especially if there is an accumulation of purulent fluid back of the retina.

Ophthalmoscopic examination will distinguish three groups: (1) Very flat and varying in size; (2) Partial, extending into the vitreous; (3) Complete or funnel-shaped.

The first may not be easily recognized unless in the detached retina there are folds. These generally run nearly parallel and the vessels bend over or appear abruptly cut off at the edges of the folds.

In the second form there will be seen a shining white, bluish, yellow, or greenish-white color, instead of the normal red fundus. This form is usually extensive and a tremulous motion of the affected area is imparted when the eye is moved. It will also be found in a plain anterior to the undetached retina, and the difference in focussing will determine the extent of the lesion. Nearly always the direction assumed is downward. Detachments at the macula are seldom found. It is unusual for both eyes to be affected.

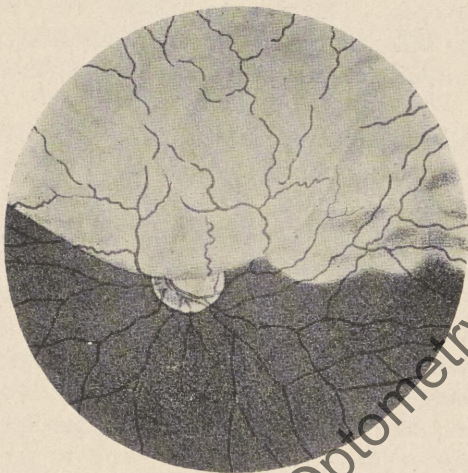


FIG. 84.—Detachment of the Retina in a Myopic Eye (indirect image).

The color of the detached retina will vary according to its transparency and the condition of the sub-retinal fluid. With a transparent retina and clear sub-retinal fluid, the change in appearance may not be easily recognized, but tremulousness of the affected part will determine the lesion. The different colors which may be seen are usually dependant upon the color of the fluid back of the detached portion, unless the retina is opaque, when a grayish color will be observed.

Ruptures of the retina are not infrequent in these cases, and if the edges are separated the choroidal vessels can often



be plainly seen. In extensive detachments, the blood-vessels may be dark or black in color. In the later stages, changes in the circulation results in shrinkage of the vessels.

In the third division, the retina may assume a funnel shape, the red fundus reflex is lost, and the various colors already described may prevail over the entire visible area.

In cases of long standing, hemorrhages, pigment masses, deposits of lime and cholesterine may be found. Synchysis and opacities of the vitreous are often seen, being more frequent in myopes. The posterior portion of the lens may be cataractous, and this condition may progress to a complete opacity. Chronic retinitis with synechiæ may also be a complication.

Visual defects are proportional to the extent and location of the lesion. Sensation of light is often absent in the detached portion. If the detachment is in the macular region, central vision will be reduced, and as a rule both light and color senses are impaired. Metamorphopsia may be present. Photopsia and chromopsia frequently add to the patient's discomfort.

Detachment of the retina is not an uncommon disease. Men are more often affected than women. It is seldom seen in early life, occurring oftenest between the ages of forty-five and sixty.

*Causes.*—Besides those already mentioned, which may be classed as direct, there are others which may be termed indirect, as excessive physical exertion, intense emotion, sexual and alcoholic excesses, pregnancy and parturition, hot baths, etc.

*Diagnosis.*—In extensive detachment there is no difficulty in making a diagnosis. Oblique illumination will often reveal this condition, should it escape observation by the unaided eye. If vitreous opacities are numerous, interfering with an ophthalmoscopic examination, the field of vision should be taken. A very important diagnostic point with

the ophthalmoscope is the absence of light reflex from the vessels over the detached portion.

*Prognosis.*—Unfavorable. In some cases reposition of the retina has taken place.

*Treatment.*—Rest in the supine position with the eyes covered, but ordinarily not bandaged. Motion of the eyes should be restricted. Jaborandi, or its alkaloid pilocarpine, in full physiological doses has appeared to have a good effect. Solution of sulphate of eserine has been reported as having a beneficial action. Small doses of salicylic acid have been recommended.

Operative measures as a rule are worse than useless. In cases of spontaneous or traumatic detachment, if there is sub-retinal fluid, scleral puncture, evacuating the fluid, might be beneficial, otherwise operative proceedings should not be undertaken.

**RETINAL HEMORRHAGES** (Apoplexy of the Retina).—These may be incidental symptoms of some forms of retinitis, or occur spontaneously during systemic diseases, or diseases of the eye itself. Traumatism may also be a factor. Change in the walls of the vessels, or in the blood itself are the usual causes.

By means of the ophthalmoscope the hemorrhages may appear as light or dark spots, there may be a white rim around these, or through degeneration, the areas may have a whitish color. Infrequently a pigmentary change may take place. The hemorrhages may be minute or include the entire retina. When small, and in the nerve fiber layer, they are flame-shaped or stippled, and radially placed. In the deeper layers they may assume a rounder form. The macula is a favorite location, the next choice appearing to be the larger vessels.

Hemorrhages commencing in the external sheath of the optic nerve may appear at its margin, gradually spreading into the surrounding retina. Hemorrhages from the retinal vessels are usually extensive, and are located between the



internal limiting membrane of the retina and the hyaloid membrane of the vitreous. These are most likely to occur at the fovea. In some cases the hemorrhages may enter the vitreous.

The visual disturbances will depend upon the location, size, and number of the extravasations. When in the macula, central vision is usually destroyed. Should they occur in the periphery the defect may be none, or very slight.

*Causes.*—Diseases which may be instrumental in producing

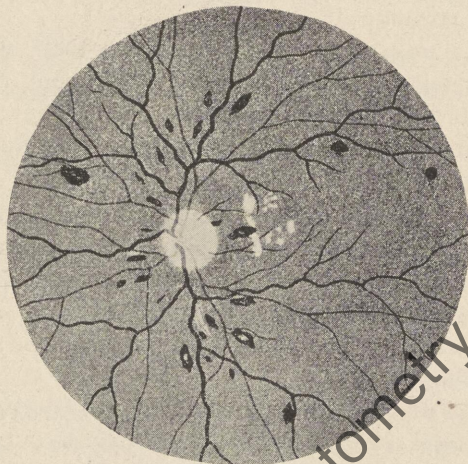


FIG. 85.—Pernicious Anemia. The papilla white, arteries contracted, and veins distended. Atrophic areas near the disk, and hemorrhages over the fundus.

this condition are, morbid states of the kidneys, liver, spleen; septicemia, simple or pernicious anemia, hemophilia, gout, atheroma of the vessels; organic heart disease, thrombosis of the central vein, embolism of the central retinal artery, or menstrual anomalies. Following severe burns of the skin, retinal hemorrhages are often found. Traumatism either accidental or operative, in which there is sudden reduction of the tension; e. g., following iridectomy in glaucoma. Some

toxic agents, as phosphorus, venom of serpents, or chlorate of potassium may also produce hemorrhages.

*Prognosis.*—The location and extent, as well as the exciting cause, will influence the final results.

In old people, cerebral hemorrhages may follow. Hemorrhagic glaucoma, vitreous opacities, or detachment of the retina may also result.

*Treatment.*—Absolute rest of the eyes, and avoidance of physical or mental exertion will be essential. In old persons the instillation of a weak solution of sulphate of eserine. Internal medication must be directed to the supposed cause. Cardiac sedatives in many cases. Jaborandi, bryonia, or ergot. As a rule in elderly persons, the use of belladonna must be carefully watched, as the effect may be similar to instillations of sulphate of atropine in the eye.

**EMBOLISM OF THE CENTRAL RETINAL ARTERY.**—This means either a complete or partial obstruction of the artery or one of its branches by an embolus.

Sudden blindness of the affected eye usually occurs, and the ophthalmoscopic appearance is characteristic. Total embolism is immediately followed by marked anemia of the fundus. The papilla is pale, or yellowish white, but lacks the shining look of true atrophy. The arteries are filiform and can be traced but a short distance from the disk. In some cases thread-like columns of blood may be seen in the larger arteries. Occasionally coagulated blood may be distinguished in some of the peripheral branches. The walls may have a white border. The veins are contracted, but not as much as the arteries, and are relatively broader towards the periphery than at the disk.

Opacities of more or less density form in the region of the papilla and macula, which, if very opaque, may give a milky white look. Corresponding to the fovea centralis, the macula contains a blood red spot, or as it is called the "cherry red spot." Very rarely this spot is lacking, or the color may be black.



Several theories for the explanation of this appearance at the fovea have been given, but none appear satisfactory. The contrast of colors may make the intensity more marked.

Some circulation returns to the affected area after a longer or shorter period, and according to Schnabel, is explained by the fact that to the embolus alone is not due the extreme retinal ischemia, but that secondarily there is a spastic contraction of the walls of the vessels. When this spasm disappears the lumen of the vessels is no longer completely obstructed, some blood being able to pass, and thus partially restore the circulation. When this has occurred, retinal hemorrhages may be seen, especially in the macular region.

In the later stages of the disease the papilla is pale, dirty, or yellowish-white, atrophy occurring. The retinal arteries are excessively contracted and can be traced but a short distance from the disk. The veins are straight and much contracted.

An embolism may occur in some of the branches of the central retinal artery, when the ophthalmoscopic appearance will be the same as total, excepting that the change is confined to the area supplied by the affected vessel.

The embolus may be visible as a yellowish body, but usually all that can be discovered may be a swelling at some point in the artery, with more or less partial obliteration of the artery on the distal side.

*Subjective Symptoms.*—Usually sudden loss of vision. In some cases transitory dimness of vision or blindness may precede the embolism, and there may be giddiness, headache and faintness. The attacks may be a partial or complete obscuration of the field of vision, and have been reported in the fellow eye, but these symptoms are usually the result of *thrombosis of the central retinal artery*. If the obstruction is in one of the retinal branches, the corresponding field will be affected, but central vision may be comparatively good. In some cases there will be temporary improvement in vision through return of the circulation, but it is finally lost. In

one case under observation, the improvement lasted four months. If a cilio-retinal vessel is present, a fair amount of vision may be preserved.

Intra-ocular tension may remain normal, or it may be increased or diminished. The pupil in typical cases may be dilated and without reaction to light.

*Causes.*—In the majority of cases results from valvular heart disease, arterial sclerosis, aortic or carotid aneurism, albuminuria and pregnancy; chorea has also been credited in a few instances as being a cause. No period of life is exempt. Usually but one eye is affected.

*Diagnosis.*—The appearances described indicate some obstruction of the retinal circulation, but is not proof positive of embolism. Thrombosis, or hemorrhages into the optic nerve sheath, may produce very similar appearances.

*Prognosis.*—When of the central retinal artery it is always bad. If of one of the branches, more or less vision may remain.

*Treatment.*—Seldom any permanent improvement can be obtained. Operative measures have proven unsuccessful. Massage of the eyeball has in some instances been followed by good results. Partial absorption of the clot may be obtained in very recent cases by the use of jaborandi, but the main reliance must be treatment directed to the cause, which unfortunately in this disease promises but little.

**THROMBOSIS OF THE CENTRAL RETINAL VEIN.**—This condition is usually seen in subjects from sixty to seventy years of age.

Michel classifies three forms: (1) Total thrombosis of central retinal veins; (2) Partial thrombosis; (3) Simple stasis, the result of a small thrombosis.

In the first, the papilla and surrounding retina seem suffused with blood. The margin of the disk is indistinct. Surrounding the zone of suffusion, there are numerous circumscribed hemorrhages varying in color, size and shape. In the zone the arteries and veins are hidden, but can be



seen towards the periphery, the veins being tortuous and thick, with the blood very dark-colored. In some cases there may be an interruption in the column of venous blood, and at this point a yellowish-white spot will show. The macula is yellowish-gray, and the fovea contains a red spot, which is hemorrhagic.

In the second form, corresponding to the zone of suffusion seen in the first degree, hemorrhagic stripes will be seen, which tend towards the macula. The rest of the fundus presents a similar appearance to that already described.

In the third type, there are few hemorrhages. The veins are tortuous, thick and filled with dark-red blood, while the arteries appear thin. If the occluding thrombus becomes organized, complete loss of sight will result, but if there is either partial or complete disintegration of the obstruction, improvement of vision will follow.

Michel states that there is not as much reduction of vision as in embolism. Angelucci, on the contrary, found a sudden total blindness in his patients and an absence of retinal hemorrhages, the patients being all young persons.

*Causes.*—In the majority of cases arterio-sclerosis is present. Cardiac lesions have also been supposed causes.

*Prognosis.*—Will depend upon the amount of obstruction, the permanency, and whether there are relapses with hemorrhages entering the vitreous.

*Treatment.*—Improvement of the general health and administration of jaborandi or *pux vomica*. Attention to the supposed cause is imperative.

RETINAL SYMPTOMS FROM TRAUMATISMS.—Amblyopia, anesthesia, rupture, and detachment may result from traumatism. Distinctive characteristic symptoms are not present in all types, but pain resulting from the injury, and visual disturbances, due partially to transient astigmatism, are usually present.

I. TRAUMATIC ANESTHESIA.—Leber gives this name for cases in which diminished vision and contraction of the

visual field, which may be persistent for a long time, or even permanent, is present without discernible ophthalmoscopic changes.

*Prognosis.*—Guarded.

*Treatment.*—Avoidance of physical and mental exertion. Nux vomica, belladonna, or jaborandi internally.

2. TRAUMATIC AMBLYOPIA (Commotio Retinæ).—This may result from a blow on the eye, as a cork, ball, etc. An opalescent gray appearance of the macular region and surrounding the disk, which may be hyperemic, will be seen. If the point of impact can be observed, whitish infiltration may also be discoverable. Small hemorrhages may be present. Changes in the blood-vessels are infrequent, but when they do occur the arteries are contracted and the veins dilated. Central scotoma may be present. A transient astigmatism is not infrequent in these cases.

The retinal opalescence forms rapidly and is usually rapidly absorbed, no trace being left after a few days, but the visual defect may remain for some time.

*Prognosis.*—This will depend upon the severity of the injury. A retino-choroiditis may follow the traumatism, causing permanent visual defects.

*Treatment.*—Dilatation of the pupil with a mydriatic, and protection of the injured eye from bright light. All use of the eyes should be interdicted.

3. DETACHMENT OF THE RETINA.—This has already been spoken of.

4. RUPTURE OF THE RETINA.—Seldom occurs, unless complicated with rupture of the choroid.

*Diagnosis.*—By being able to discern the choroid through the retinal fissure.

*Prognosis.*—Unfavorable.

RETINAL CHANGES RESULTING FROM SUNLIGHT AND ELECTRIC LIGHT.—Retinal changes may result from exposure to intense sunlight (*solar retinitis*), as well as intense electric light (*electric retinitis*), as in electric welding.



*Symptoms.*—A persistent after image, or dark spot in the field of vision (positive scotoma). Objects may also be distorted. In the macular region very slight evidences of retinitis, or retino-choroiditis may be present.

*Prognosis.*—Favorable as regards improvement, but it is seldom that a complete recovery occurs.

*Treatment.*—Same as retino-choroiditis. Preventive measures consist in wearing tinted lenses of yellow, a combination of red and blue, or as in Sheffield several layers of ruby glass.

**GLIOMA OF THE RETINA.**—A malignant tumor starting from the retinal tissue, and seen only in childhood.

Either a circumscribed or a diffuse form may develop. The former is the most frequently seen and may extend forward into the vitreous (glioma endophytum) or backward between the retinal and choroidal structures (glioma exophytum). Detachment of the retina may follow either form, but is less often seen in the former, and seldom in the diffuse type. The choroid and optic nerve may be implicated.

A bright white, yellowish, golden-yellow or red tinted pupillary reflex from the child's eye will probably be the first indication noticed that there is any morbid condition present. This may be noticeable from quite a distance and has been termed "*amaurotic cat's eye*." The pupil is dilated and often there are no signs of irritation or inflammation in the early stages.

The first stage is seldom seen, as it can only be discerned by means of the ophthalmoscope; by this method a whitish spot, sometimes a little prominent, and surrounded by smaller spots, may be seen. Newly formed blood vessels are also generally present.

In the second stage there is usually increased tension, the eye is irritated and painful, and the patient exhibits signs of fretfulness and suffering. Emaciation may commence in this stage, and the amaurotic cat's eye will be noticed. The reflex may be whitish, or of a red tint; small hemorrhages,

and white degenerative patches are sometimes seen by the ophthalmoscope. The anterior chamber is usually shallow, the pupil dilated and the iris sluggish. Tension may be normal and vision is usually destroyed.

This is the stage most frequently seen by the physician, as the peculiar reflex will be noticed by the parents.

The third stage is the glaucomatous stage, or an iridocyclitis may be present, but this seldom occurs. Frequently there will be a pericorneal zone of a bluish-red tint, and at times chemosis. The cornea presents a dull surface, with slightly opaque spots. The anterior chamber is lessened in depth, and the aqueous becomes turbid, the pupil widely dilated and the iris muddy looking and immobile.

In the fourth stage, the glaucomatous condition will produce more or less dilatation of the ball, as in children the elasticity of the tissues is greater than in adults; corneal anomalies may result, as megalocornea, or keratoglobus. Atrophy of the ball follows this condition.

If operative interference is delayed, the morbid mass will perforate the ball, and the growth may follow the optic nerve, involving the orbital tissues, and exophthalmos result.

The sclera may become staphylomatous, and the mass perforate the atrophied tissues, or the tissues of the sclera itself may partake of the morbid process, the fibers become loosened and eventually a glio-fibroma may develop, the glioma protruding through the net work.

The cornea may be the tissue invaded in which case the growth may escape through a corneal rupture, the result of pressure atrophy, through invasion of the corneal tissue in a manner similar to that sometimes seen in the sclera; or by sloughing of the cornea, following a secondary keratitis.

Other methods of egress are occasionally seen.

After the glioma has reached the exterior of the globe, the growth is very rapid, involving all the contiguous structures, and may attain an enormous size before death results.



The majority of cases are seen prior to the age of three years, although cases as old as twelve years have been reported. The congenital form usually attacks both eyes. The growth consists of neuroglia, ganglion cells, and nerve fibers.

*Causes.*—No known factor has been discovered.

*Diagnosis.*—Attention to the appearances described should eliminate errors of diagnosis.

*Prognosis.*—Very bad, as death usually results.

*Treatment.*—If seen before a quarter or third of the vitreous chamber is filled by the growth, the chances are more favorable for good results, unless the optic nerve is diseased. After the globe is filled with the mass, the chances of success are much reduced, and after perforation of the ball, especially if the orbital tissues are affected, the chances are still more diminished. If enucleation is performed, the nerve should be divided as far back in the orbit as possible.

Recurrence is not infrequent, and metastases to distant organs have been reported. When the orbital tissues are diseased the entire contents should be removed. Medication is useless, excepting such means as will relieve the patient from pain.

**CYSTICERCUS CELLULOÆ (Sub-Retinal Cysticercus).**—Very seldom seen in this country, and the prognosis is unfavorable. If the case is seen early, before much damage has been done to the retinal tissues, the successful removal of the parasite may result in useful vision remaining.

**AMAUROTIC FAMILY IDIOCY (Sachs), Symmetrical Changes of the Macula Lutea in Infancy.**—This disease usually appears during the first year. Mental development is arrested, and an imbecile condition is established. Paresis or paralysis of the body may be present. Vision becomes reduced or entirely lost. Nystagmus or strabismus may first call attention to the eyes. Marasmus usually supervenes, finally resulting in death, which occurs within a year or two of the onset of the disease.

The ophthalmoscopic picture in the early stages shows normal looking papillæ, but in the macular region of each eye a diffuse white spot, about double the size of the disk, will be seen. In the center of this area a brownish red, nearly circular spot, resembling somewhat the appearance seen in embolism of the central retinal artery will be noticed. Atrophy of the optic nerve follows.

Hirsch states that morbid changes are present, not only in the nerve cells of the brain, but also of the entire nervous system. Degeneration of the pyramidal cells of the cerebral cortex, and similar changes in the retinal ganglion cells are present. Sachs refers the cerebral changes to arrested development.

*Causes.*—A hereditary predisposition usually seems to be present in these cases. Consanguinity of the parents and morbid neurotic conditions will usually be noticed. In one case under observation, there was, so far as I could discover, no abnormal family history for three generations. The child was the only one in a family of six who had ever shown any eye lesion. The child died within six months from the time I first saw it, and a postmortem was refused.



## CHAPTER XIV.

### THE OPTIC NERVE.

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The nerve-fiber bundles of the retina combining and emerging from the eyeball at the scleral foramen, compose the optic nerve. This consists of bundles of medullated nerve fibers separated from each other by connective tissue. The white tissue substance of Schwann is usually first found after the bundles pass through the cribriform lamella, and on account of this structure at the point of exit the nerve is smaller than the rest of the intra-orbital portion.

The lamina cribrosa is important in morbid conditions of the eye, as it is the weakest point in the tunics of the ball, composed as it is of the inner layers of the sclera with a few choroidal lamellæ, and still further weakened by the foramina, which transmit the nerve fiber bundles. Increased intra-ocular tension will cause this portion to give way first. The nerve within the limits of the lamina cribrosa is contained within firm fibrous walls, which, in swelling of the nerve, produces constriction and strangulation, not unlike in effect that produced by the fibrous ring of hernia on the distal portion of the viscera.

Lying anteriorly to the cribriform lamina is the papilla, optic nerve head or optic disk, and is the visible ophthalmoscopic portion of the nerve. The center is normally occupied by a depression, the physiological cup from which the central retinal artery emerges.

The orbital portion of the nerve passes obliquely and with distinct curves from the eyeball to the optic foramen. This deviation from a direct line allows not only of free movement

of the eyeball in all directions, but also of more or less exophthalmos. The mobility of the eyeball is lessened the more pronounced the protrusion. The orbital portion of the nerve is composed of the nerve trunk and its enveloping sheaths. As stated, the optic nerve is made up of nerve

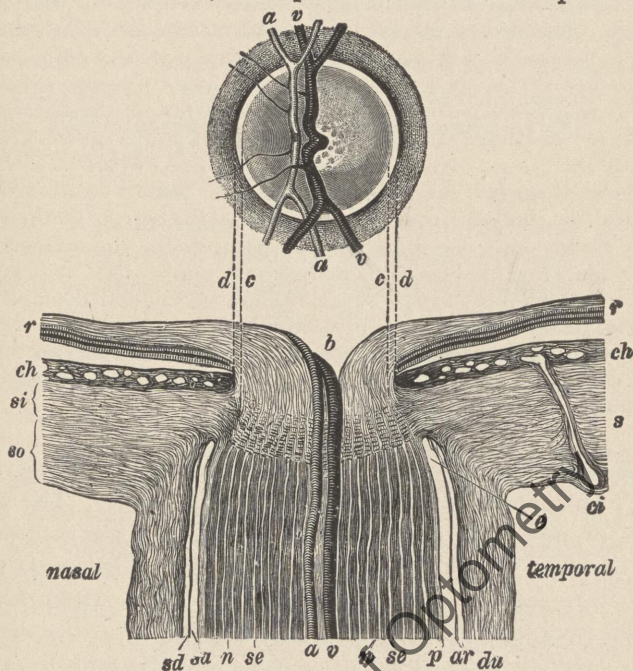


FIG. 86.—HEAD OF THE OPTIC NERVE.—A, Ophthalmoscopic View. Somewhat to the inner side of the center of the disk is the central artery, and to the temporal side, the central vein. The physiological cup and the stippling of the lamina cribrosa lie externally to the vein. The light scleral ring, between *c* and *d*, and the dark choroidal ring *d*, surround the disk.

B, Longitudinal Section through the Head of the Optic Nerve, magnified 144x. The trunk of the nerve up to the lamina cribrosa has a dark color, because it consists of medullated nerve fibers, *n*, which have been stained black by Weigert's method. The clear interspaces, *s*, separating them, correspond to the septa composed



of connective tissue. The nerve-trunk is enveloped by the sheath of pia mater, *p*, the arachnoid, *ar*, and the dura, *du*. There is a free interspace remaining between the sheaths, the subdural, *sd*, and subarachnoid, *sa*. Both spaces have a blind ending in the sclera at *e*. The dural passes into the external layers, *sa*, of the sclera, the pial into the internal layers, *si*, which latter extend as the lamina cribrosa transversely across the course of the optic nerve. The nerve in front of the lamina is represented as of light color, because here it consists of non-medullated and transparent nerve-fibers. The optic nerve spreads out upon the retina, *r*, in such a way that in its center there is produced a funnel-shaped depression, the vascular funnel, *b*, on whose inner wall the central artery, *a*, and the central vein, *v*, ascend. The choroid, *ch*, shows a transverse section of its numerous blood-vessels, and toward the retina a dark line, the pigment epithelium; next the margin of the foramen for the optic nerve, and corresponding to the situation of the choroidal ring, the choroid is more darkly pigmented. *ci* is a posterior short ciliary artery which reaches the choroid through the sclera. Between the edge of the choroid, *d*, and the margin of the head of the optic nerve, *c*, there is a narrow interspace in which the sclera lies exposed, and which corresponds to the scleral ring visible with the ophthalmoscope.—*Fuchs*.

fibers and connective tissue. Separating the fibers and acting as a support to them is the neuroglia tissue. The bundles of nerve fibers are arranged parallel and are connected with each other by an exchange of fibers. The supporting structure for the nerve is connective tissue, which forms connecting septa, and which are found in the entire nerve. The outer surfaces of the nerve fiber bundles and the inner surfaces of the septa are separated, the spaces forming lymph cavities.

The sheaths of the nerve are three—inner, middle and external. These are designated as the pial, arachnoid and dural, as they originate from the corresponding cerebral membranes.

The pial sheath closely invests the nerve trunk, and as it also forms the supporting septa of the nerve, and accompanies the blood-vessels, it is distributed throughout the entire nerve.

The arachnoid sheath is so intimately connected with the dural or outer sheath by trabeculae, that the two are separated by a very shallow, irregular space, the sub-dural space, continuous with the corresponding cerebral space. Between the arachnoid and pial sheath is a wider space, the sub-arachnoid, and continuous with the same cerebral space. Trabeculae and bands from the arachnoid cross this space to the pial sheath. This space is covered more or less by endothelial plates, as also are the lymph spaces of the nerve. These constitute the lymph spaces.

The dural sheath is a continuation of the cerebral dura mater. It is intimately connected with the nerve at the optic foramen, but it loosely covers the intra-orbital portion until it reaches the eyeball, where it, in conjunction with the other sheaths, are united with the sclera. The outer and middle blending with the external portion of the sclera, the inner going to the inner scleral coat and choroid, entering into the structure of the lamina cribrosa.

The *blood vessels* enter the nerve from the inner sheath.

The nerve passes from the orbit through the optic foramen, accompanied by the ophthalmic artery, which lies below and on the outer side. The intra-cranial portion of the optic nerve is short, reaching only from the optic foramen to the chiasm. The nerve is invested only by the pial membrane, the others being connected with the corresponding cerebral membranes on passing the foramen.

At the chiasm, which is just beneath the floor of the third ventricle, the two optic nerves join, the fibers intermingling and decussating, appearing again on the posterior part of the chiasm, or commissure, as the optic tracts.

The arrangement of the fibers in the chiasm is not well understood. From the geniculate bodies the fibers of the nerve pass to different portions of the brain. Of especial importance are the fibers that go to the oculomotor nuclei, and those which reach the cerebral cortex. The first group evidently controls the movements of the ocular muscles and



sphincter of the iris, while the latter, or second group, are instrumental in conveying the visual impulses to the receptive cerebral area, where the molecular motion is analyzed and conscious vision results.

The most generally accepted theory of the arrangement of the optic-nerve fibers in the chiasm is, that there is only a partial decussation of the fibers. The majority of the fibers from the temporal retinal portion are reflected from the corresponding part of the chiasm to the same side of the brain, while the majority of those from the nasal side of the fovea cross and reach the opposite cerebral hemisphere. By this arrangement fibers from both eyes are contained in each optic tract.

The probability of a distinct system of fibers from the macular region has been advocated and undoubtedly will be proven. The arrangement of these fibers will probably not vary from that already given. This hypothesis of nerve distribution would give the right half of each retina or the left half of each visual field to the right optic tract. "*Everything which the observer sees on the left side of him becomes an object of consciousness through excitation of the cortex of the right occipital region, and vice versa.*"—Fuchs.

The fact that all of the fibers do not decussate accounts for hemianopsia. When the defect is found in both visual fields, destroying vision for the same side of an object, it is called homonymous hemianopsia. If communication is destroyed between the nerve fibers from the left halves of both retinae, and the left cerebral cortex, the right half of each visual field is defective, and only the left half of fixed objects would be seen. The same condition may result when the defect is situated in the cortex of the brain. Homonymous hemianopsia is always evidence of a defect of the cortex, or the visual tract, and is located on the same side as the blind retinal area.

HORIZONTAL HEMIANOPSIA, either superior or inferior, may result from some lesion at the chiasm, or symmetrical





vertical meridian. This passes through the fovea centralis, *f*, in which the visual lines drawn from the fixed point, *F*, impinge upon the retina. The optic nerve-fibers arising from the right half, *r* and *r1*, of the two retinae (indicated by the dotted line) all pass into the right optic tract, *T*, while the fibers belonging to the left half, *l* and *l1*, of the two retinae pass into the left optic tract, *T1*. The fibers of each optic tract for the most part pass to the cortex of the occipital lobe, *B*, forming Gratiolet's optic radiation, *S*; the smaller portion of them, *m*, goes to the oculo-motor nucleus, *K*. This consists of a series of partial nuclei, the most anterior of which sends fibers, *P*, to the pupil (sphincter iridis); the next one sends fibers, *A*, to the muscle of accommodation; and the third sends fibers, *C*, to the converging muscle (internal rectus, *i*). All these bundles of fibers run to the eye in the trunk of the oculo-motor nerve, *Oc*. Division of the optic tract at *gg* or *ee* produces right hemiopia; and in the former case there would be no reaction to light on illuminating the left half of either retina. Division of the chiasm at *ss* produces temporal hemiopia. Division of the fibers, *m*, abolishes the reaction of the pupil to light, but leaves the sight and also the associated contraction of the pupil in accommodation and convergence unaffected.—*Fuchs*.

TEMPORAL, HEMIANOPSIA, that is the temporal portions of the visual fields being suppressed, may occur where the lesion is confined to the anterior or posterior angle of the chiasm interfering with the crossed fibers.

HETERONYMOUS HEMIANOPSIA (Nasal Hemianopsia).—This defect has not been found in affections back of the chiasm. Lesions of both nerves have been found in a few cases. The nasal fields of both eyes are destroyed, but the dividing line may be irregular. Ophthalmoscopic changes are usually present, as swelling, hemorrhage, or in the later stages, atrophy.

ANOMALIES OF THE NERVE.—*Coloboma of the Sheath*.—A partial or complete coloboma of the sheath may exist. If partial, there will be at the inner or lower portion of the papilla a deep cup. Part, or all of the outline of the disk may be seen. At the margin of the coloboma the retinal vessels may abruptly disappear, but may re-appear again at

a more elevated portion of the papilla. If the coloboma is not abrupt the vessels will gradually disappear. *Choroidal coloboma* may also be present in these cases. The defect results from imperfect closure of the fetal cleft.

Other anomalies may be changes in the direction of the nerve head, reversing the normal appearance.

The disk may be oval instead of round. This, if physiological, and not the result of astigmatism, will be determined by the indirect ophthalmoscopic examination, when it will retain its position, but if it is astigmatic, the long axis will be at a right angle to that seen by the direct method.

Irregularities of outline of the disk sometimes occur, Loring describes a condition of "cone" or "conus" to a space occasionally found, usually crescentic in appearance, sometimes present in cases where the nerve head does not accurately fill the choroidal opening. Usually found on the temporal side but may be on the nasal, more rarely below and seldom above.

Pigmentation may also be present as well as absence of central retinal vessels.

Glistening white shreds or patches of tissue are sometimes seen. They may be nearly transparent or quite opaque, and may either partially or completely obscure the vessels.

*Circulation.*—The optic disk depends mainly upon the retinal vascular system for its blood supply, but some diagnostic features may be noticed in the vessels of the papilla. Venous pulsation is not infrequent, and is of no especial diagnostic value unless of recent occurrence. In normal conditions it may be noticeable, and also after the inhalation of nitrite of amyl, being synchronous with diastole. In morbid states it is more pronounced, as in aortic insufficiency without a compensating hypertrophy, and in tricuspid insufficiency it may begin during systole.

Arterial pulsation is normally absent; hence, when present, it may be of much diagnostic value. It may be seen



in aortic insufficiency, and there may occasionally be rhythmic reddening of the entire disk, the "pulse" of the papilla. When the blood pressure is much reduced, as in marked anemia, arterial pulsation is infrequent. In aortic aneurism it is not often observable, but may at times be marked in the left eye, when the aneurism is near the left carotid. Arterial pulsation is sometimes seen in Basedow's disease. The most significant feature of arterial pulsation is its occurrence in glaucoma.

Compression of the central retinal artery, even some distance back of the eyeball, may produce rhythmic filling and emptying of the veins, even with normal tension.

ANEMIA OF THE PAPILLA.—This depends upon systemic diseases or obstruction of the central retinal vessels; it may be found in chlorosis, pernicious anemia and leukemia, when a waxy, yellow pallor will be seen. In cinchonism it is sometimes seen. Ligation of the common carotid will also cause anemia of the nerve on the same side.

*Treatment.*—The systemic condition must be controlled, when the disturbance will disappear.

HYPEREMIA OF THE PAPILLA (Congestion of the Disk).—The color of the disk normally varies, but an increased redness is found in inflammatory states of the tunics of the eye. In ametropic conditions, especially hyperopia and hyperopic astigmatism, and excessive use of the eyes or continued exposure to bright light or heat, hyperemia is often found. Severe cardiac lesions may also produce this effect, as well as secondary syphilis and advanced diabetic cases, even where lesions of the nerve cannot be detected.

Nervous disturbances may also produce hyperemia of the disk, long periods of wakefulness, alcoholic excesses, etc. Neurotic patients will often show hyperemia. Chlorotic girls at puberty are often subjects of this condition, and it may also be seen at the menopause.

The victims of hyperemia from nervous disturbances often complain of pain in or back of the eyeball, pressure about

the eyes, headache, either frontal or temporal, and muscæ volitantes are nearly always present. In these cases a quivering contraction of the upper lid may be noticed when requested to close the lids gently, and also a nystagmic motion of the eyes when an attempt to examine them is made.

The ophthalmoscopic picture in neurotic cases is usually marked, the papilla being bright red, differing from simple congestion, which is a dull red. The margin may or may not be blurred. If but one eye is affected, the condition is easily detected by comparison of the two eyes.

The patient usually complains of defective vision, but if it appears to be reduced one-third or more, and not enough ametropia is present to account for this reduction, it may be concluded that hysterical amblyopia or amaurosis is present.

*Prognosis.*—Favorable, but a considerable period of time may be required.

*Treatment.*—If marked ametropia is present, or even a slight degree of astigmatism, the refractive error should be carefully corrected. In those cases of hysterical amblyopia, where the refractive condition is nearly normal, the effort should be made to improve vision and eliminate the psychological phase, by placing before the eyes weak plus and minus lenses, which neutralize each other. The patient thinking that correcting glasses are before the eyes, will usually show an improvement in vision, often the normal acuity being obtained for both distance and near. In nervous asthenopia this method will often afford relief.

In neurotic patients, suggestion will often accomplish more than medicines in relieving the symptoms complained of.

In chlorotic cases cuprum is often indicated. In marked anemia, iodide of arsenic. In cardiac lesions, cactus, strophanthus, digitalis or nitro-glycerine. Belladonna or ergot will often be indicated. Gelsemium or jaborandi are drugs, which, when the indications are present for their use, will be followed by good results. Pulsatilla in apprehensive cases, and at times also the bromides will be found to have



a beneficial action, as they will relieve many of the nervous symptoms. The alimentary tract must be kept in active working condition.

Locally, the use of the morphine and hydrastis collyrium will afford relief, if there is any conjunctival irritation. Avoidance of excessive heat, light and fatigue is necessary.

HEMORRHAGE IN THE PAPILLA.—Independently of retinal hemorrhages or inflammatory lesions of the optic nerve, there may be isolated hemorrhages. These usually are found associated with serious lesions of the circulatory system. The hemorrhages are found most frequently in the middle-aged, but no period of life is exempt. In old age arterial sclerosis may be a cause.

*Diagnosis.*—The ophthalmoscopic examination will show disturbed circulation in both eyes when it results from heart disease, and in arterial sclerosis the arteries will be pale, probably distended, and showing a broad central band, interrupted in places, and presenting some shining reflections. The extravasations may occupy only a small portion of the disk, or one-half of it may be affected. A deep black surface presenting, which usually extends beyond the margin of the disk. The hemorrhage is in the nerve-fiber layer.

Some mistiness of vision or discomfort on using the eyes will usually be complained of. When the hemorrhage is on the temporal side of the nerve the disturbance of vision is more marked.

*Prognosis.*—Usually favorable. If the extravasation is the result of arterial sclerosis, however, there will probably be cerebral hemorrhages later.

*Treatment.*—Hygienic measures. Rest of the eyes and of the physical and mental systems, as well as avoidance of intense light. Anything having a tendency to produce congestion or blood stasis should be avoided, as stooping, lifting, or wearing of tight collars. The bowels should not be permitted to become inactive, and all stimulants should be prohibited. In cardiac lesions the remedies spoken of under

hyperemia should be employed. For promoting absorption of the extravasations, jaborandi and bryonia. If the indications for iodide of potassium are present, the drug should be administered in small doses. All general constitutional disturbances should receive proper treatment.

**INTRA-OCULAR NEURITIS (Papillitis, Choked Disk, Neuritis).**—The different types of inflammation observed at the disk are termed *papillitis*, even when the appearances of mechanical congestion are lacking.

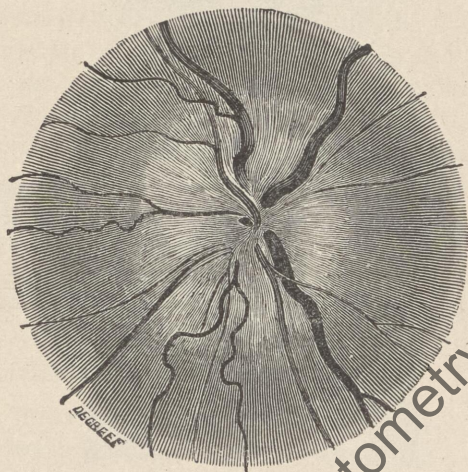


FIG. 88.—Optic Neuritis. Ophthalmoscopic View of the Papilla.

[Fox and Gould.] The papilla appears considerably enlarged and indistinctly outlined. It is a grayish-white color, clouded, and covered with radiating stria, extending into the surrounding retina. The retinal arteries are contracted, the retinal veins tortuous and distorted.

**Symptoms.**—In all cases a certain line of symptoms are present: (1) Change in the papilla. The disk is reddened and the margin obscured. Swelling of the disk and the light spot lost. Margin completely hidden, the center very red, while the grayish periphery gradually descends and merges into the retina. As the disease progresses the swelling increases, a mixed grayish appearance being noticeable and the



position of the disk can be determined only by the convergence of the blood-vessels.

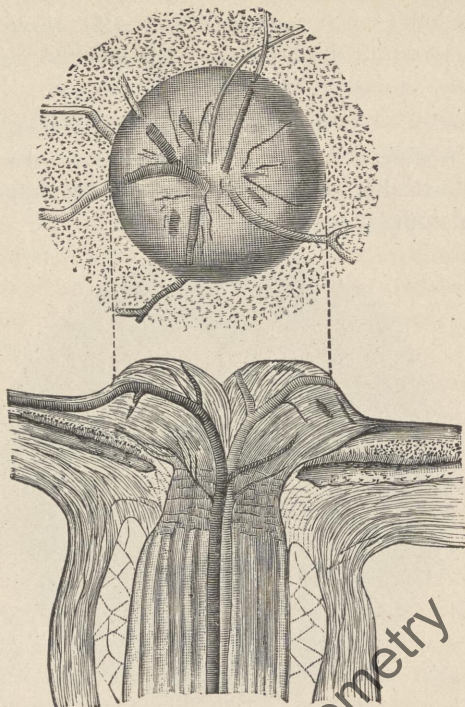


FIG. 89.—Optic Neuritis. Longitudinal section through the head of the Optic Nerve. [*Fox and Gould.*] The nerve-head is swollen, projecting above the surrounding retina. The inter-vaginal space is distended by fluid. The ophthalmoscopic view of the head is not characteristic. [see Fig. 88.]

The amount of the swelling can be estimated by the direct ophthalmoscopic method. (See table for estimation of the depth of the eye.)

White spots may be seen in the disk which sometimes partially cover the retinal vessels.

2. CHANGES IN THE VESSELS.—The arteries are smaller and straighter than usual, and are more or less covered by

the tumid tissues. Arterial pulsation is sometimes present.

The veins are distended, tortuous and dark colored, and may disappear in part of their course, as they often sink into the swollen tissue of the papilla. If the vessels are distinctly seen the central light streak will be visible. The tissues may be so swollen that the vessels at the center of the papillitis may appear to be diminished in number. Thickening of the adventitia of the blood vessels may occur, giving the appearance of white lines along the edges.

3. HEMORRHAGES.—Upon or close to the swollen disk, hemorrhages are often seen. If they are in the nerve fiber layer they are narrow and flame-shaped, but if in the deeper plane the shape varies. They may be single or multiple, and the entire affected area may appear hemorrhagic. The retina may also participate in the hemorrhagic display. Vision in these cases may not be materially affected. For this reason an ophthalmoscopic examination should always be made, even when good vision is present. As a rule one eye is more affected than the other. Diminution of vision may come on slowly or quite rapidly, and in some cases sight is quickly lost, but this seldom occurs.

4. THE FIELD OF VISION.—Peripheral vision eventually shows contraction, either regular or irregular. The blind spot increases in size, and scotoma may appear as a result of implication of the axial fibers. Hemianopsia may occur if the disease results from cerebral lesions so located as to cause this condition. Color perception is often defective when no other changes in central or peripheral vision are present. Red and green perception are usually lost first.

EXTERNAL APPEARANCES.—The exterior of the eye usually shows no change in this disease.

Characteristic pupillary manifestations are absent in the early stages. Immobility of the iris occurs only in complete blindness.

Symptoms of irritation are rarely seen.



FORMS OF INTRA-OCULAR NEURITIS.—When the intra-ocular disease is the result of inflammatory action in the orbital portion of the nerve (retro-bulbar neuritis) extending to the papilla, it is called descending neuritis. If there is implication of the retina, neuro-retinitis.

Intra-ocular neuritis or incipient choked disk is the term employed for those cases in which the most elevated point of the swollen disk is less than 3.00 D. from the level of the retina. When the distance is in excess of this, the term *choked disk* is applied. Leber uses the term *papillitis* to designate these conditions. As a rule both eyes are affected.

*Prognosis.*—Simply a hyperemia of the disk alone must not be mistaken for papillitis, but a careful, methodical examination should always be made, and if any doubt exists, repeated examinations will be necessary in order to eliminate errors.

*Causes.*—Tumors of the brain or meninges, as well as meningeal inflammation are the commonest causes. It is supposed that papillitis does not follow in morbid growths of the medulla. Tumors of the cerebellum appear to produce a more aggravated type than those of the cerebrum. Septic and epidemic meningitis, cerebral abscess, hydrocephalus and orbital tumors are less frequent causes. Albuminuria may also be a factor as well as chlorosis. Circulatory lesions, emphysema or neoplasms of the nerve have also been credited as causes.

Persistent headache will nearly always be a prominent symptom in these cases. A frequent examination of the eyes should always be made when this is complained of. Headache is also a common symptom in the early stages of albuminuria. Hysterical patients will also complain of cephalalgia, but a differential diagnosis in the latter cases is usually not difficult.

In meningeal diseases where there is direct pressure on the chiasm or tracts, the swollen disk presents a grayish white color, and there is little vascularity. Softening of the brain,

cavernous thrombosis or aneurisms may also be causes, but are less frequent. Epilepsy, myelitis and general paresis may be associated with papillitis.

Besides cerebral causes, papillitis may be present in febrile diseases and the exanthemata. Syphilis either as a direct manifestation or through gumma of the brain or meninges. Gonorrhea (Panas). Lead poisoning or other toxic agents. Extreme anemia. Menstrual disturbances. Exposure to excessive cold; rheumatism, when one eye only may be affected; cranial deformities; sun-stroke, and injuries, or excessive exertion. It may also occur idiopathically without any known cause, and has appeared as a congenital affection.

Morbid states of the orbit may be factors, and also suppurative diseases of the accessory nasal cavities. Unless both orbits are diseased the papillitis will be confined to one eye and the diagnosis may be made positive by other local symptoms.

In a few cases the neuritis has been associated with constant escape of a watery fluid from the nose. Leber considers this fluid identical with the cerebro-spinal fluid, while Priestley Smith and Nettleship ascribe small nasal polypi as the cause. In these cases headache, nausea, unconsciousness and even delirium may be present.

*Course.*—In the early stages congestion and edema of the disk occur. The swelling may be very gradual, extending over a period of months or even years, and with progressive diminution of vision. In many cases tumefaction comes on rapidly. When the inflammatory and edematous condition subsides, the veins become less tortuous and distended, and vessels which were hidden by the tumid tissues can be distinguished; this is especially noticeable at the center of the papillitis which becomes depressed. A more uniformly gray color is seen, which grows paler and as a rule, the temporal margin of the disk first becomes visible, the clearing continuing until the entire margin is seen.



The central portion of the swelling may still be covered by some of the inflammatory tissue. The disk finally becomes white and atrophic; the vessels contracted, with white tissue frequently seen along their edges. The site of former hemorrhages may be seen as elevated spots of degeneration, as well as evidences of retino-choroiditis.

*Prognosis.*—This will depend upon the exciting cause. When the case is amenable to treatment, as in many cases of syphilitic gumma, there may be recovery with good vision. Death may occur during either the first or second stages of the disease, but when it does not, blindness may gradually occur.

**THEORIES OF THE MECHANISM OF PAPILLITIS AND CHOKED DISK.**—Many theories have been advanced for this condition, but the one which seems the most plausible is advanced by Deyl. At the exit of the central retinal vein from the nerve trunk it passes through a narrow slit in the pial sheath. The edges of this opening swelling, will produce compression of the vein, thus causing a slight stasis, which frequently is the formative stage of the disease.

Whenever there is increased tension with the resultant obstruction to the passage of lymph and blood from the cranial cavity, and the intracranial pressure increasing, more and more pressure will be exerted on the nerve at the optic foramen, still further impeding the flow of blood and lymph from the optic nerve. Edema of the nerve trunk and its sheath, dilatation of the intervaginal space, and increased compression of the central retinal vein result.

*Treatment.*—The exciting cause should be ascertained, as treatment must be directed to the constitutional disease. In syphilitic cases, large doses of iodide of potassium should be given until the physiological effect is obtained. The use of mercury should be restricted to the formative stages, as after atrophy has commenced, even though the disk is still swollen, the reduction of vision will be accelerated. Inunctions of mercury will prove useful in the early stages, provided

albuminuria is not present. At the first indication of pytalism it should be stopped. The red iodide of mercury and the corrosive chloride of mercury have proven most satisfactory in the early stages however.

In anemic cases iodide of arsenic. Chlorotic cases usually require cuprum. Rheumatic cases cimicifuga, bryonia, rhus tox., Rhamnus Californica, salicylic acid or the salicylates. Menstrual disorders, cimicifuga, jaborandi, viburnum prunifolium, bryonia, and pulsatilla. To relieve the edematous condition the use of apocynum or apis, or the two combined, has afforded relief in some cases even where brain tumor was the cause of the disease.

Orbital diseases usually require surgical interference. Operations on the nerve sheath have been performed, but are of doubtful benefit.

RETRO-BULBAR NEURITIS (Orbital Optic Neuritis).—This type of neuritis differs from the preceding by having its origin in the orbital portion of the nerve.

The disease may be chronic or acute. The chronic form is often divided into toxic amblyopia and retro-bulbar neuritis proper.

The toxic form results from excessive use of alcohol, tobacco, etc. Asthma cigarettes which contain stramonium may also produce it.

*Symptoms.*—The ophthalmoscopic picture may show slight reddening of the papilla, most frequently on the nasal side, or there may be a normal appearance. If the patient persists in the excesses which cause the symptoms, there may be a temporal, wedge-shaped sector of the papilla, showing a dull pallor. A gradual diminution of vision occurs and a subdued light will give the best visual acuity. After a time close work will be impossible. Both eyes are usually affected to the same degree.

Central, oval color scotoma, especially for green and red, the green generally being the most defective, is one of the most marked symptoms. Peripheral vision for white and



the other colors normal, extending inwards to the scotoma. In very severe cases the peripheral band may be interrupted, especially in the upper outer quadrant.

*Causes.*—Besides those mentioned, bisulphide of carbon, cannabis indica, chloroform, opium and its derivatives, iodoform, lead, arsenic, chloral and diabetic toxine may cause these symptoms. Seldom seen under the age of thirty-five.

*Pathology.*—Supposed to be an inflammation of the interstitial connective tissues of the papillo-macular bundles, but Nuel thinks the disease primarily is macular, degeneration of the cells resulting, and that secondarily the optic nerve changes occur.

*Prognosis.*—Chronic but usually good if seen early and removal of the toxic agent is enforced.

*Treatment.*—In the majority of cases the removal of the exciting cause will be all that is necessary. When the disease is of long standing, the use of nux vomica will be advantageous. Dilute phosphoric acid will be indicated in many of these cases, the indications being thirst, nervous and mental anomalies, with a general atonic condition of the system. Diaphoretics, and diuretics are always of value in these cases as the poison will be more rapidly eliminated from the system, but active catharsis as a rule should be avoided.

**RETRO-BULBAR NEURITIS.**—This disease is often seen under the age of thirty, and more frequently in women. But one eye is affected as a rule.

The onset of the disease is often sudden, and there is pain in the eye, especially when the eye is moved, or on pressure. Vision is very much reduced.

The ophthalmoscopic examination may show marked redness of the disk, or it may be negative. The papilla may be quite prominent, possibly 1.00 D. and the margin of the disk abnormally colored. After several weeks the papilla becomes pallid, or the temporal portion may be a permanently white color, while the nasal portion may be pinkish.

The arteries may be slightly contracted, but often there is no change in the size of the vessels for years after the attack.

The pupils and ocular muscles are often implicated in this disease, and may be sluggish in movement.

Central scotoma is present, and is usually round, although it may assume different shapes, and as a rule is very extensive.

*Causes.*—Most frequently this disease is a manifestation in diabetes, sulphonal poisoning, syphilis, multiple cerebro-spinal sclerosis, beriberi, sulphur fume intoxication, as sometimes seen in rubber factories, and acute catarrhal states. A hereditary tendency where no known cause can be assigned is often seen, and appears to prefer the male members of the family when about the age of twenty.

*Prognosis.*—In mild cases the disease may last but a few weeks, and there may be marked improvement in vision as the morbid process declines, but the scotoma may be permanent. Blindness seldom occurs. In the more severe cases vision will be much impaired.

*Treatment.*—This appears to have but little influence as regards the eye. The constitutional lesion usually being of such a character as to not be amenable to treatment.

ACUTE RETRO-BULBAR NEURITIS.—This is distinguished from the chronic type by its sudden onset. As a rule there is severe pain in the back of the eye, frontal, temporal and vertex pains, extreme visual disturbances, commencing with dimness and ending in total blindness, possibly within a few hours, or it may be several days before this occurs. Both eyes are usually affected, but when only one, it is usually the left. Lateral motion of the eye is painful, but a rotary motion is less so. The upper lid may be widely retracted, or the lids tightly closed. Palpation of the ball is extremely painful. The pupils are dilated, and react but little if any to light stimulation when the disturbance of vision is considerable.



A close examination of the eyes is difficult, but the ophthalmoscope may show all phases, from an apparently normal appearance to that of choked disk. Hemorrhages are infrequent, or may appear as small streaks of blood at the upper and lower margins of the disk.

As the severity of the disease subsides, there is a return of vision, but central scotoma may be more or less permanent. Atrophic changes often follow, and when they occur the visual acuity is permanently impaired. The disease appears to be a primary interstitial neuritis. (Elschnig.)

*Causes.*—Toxic agents affecting the central nervous system. On account of the peculiar character of the pain in and around the eyeball, it would appear to be in many cases rheumatic or gouty, and a cold would accentuate the symptoms. Syphilis, the exanthemata and diabetes may cause it. Inflammation of the nasal tissues, or of the accessory nasal sinuses; orbital inflammation may also be an exciting cause.

*Prognosis.*—Always guarded. Under proper treatment a more or less complete recovery may be made, but central scotoma and contraction of the peripheral field may be permanent.

*Treatment.*—Attention to the supposed cause of the disease. For the severe pain, increased by motion of the eye, bryonia will give relief. A tender bruised feeling of the tissues indicates cimicifuga. The physiological action of jaborandi will also frequently afford relief. Rheumatic and gouty conditions may also require in addition the salicylates, colchium, rhamnus, iodide of potassium, etc.

The remedies required and their indications have been given under other headings.

*PERI-NEURITIS.*—This is an inflammation of the nerve sheaths. The sub-vaginal space contains granulation tissue, which extends from the pial sheath into the nerve trunk. Some portions of the inter-vaginal space may be obliterated by the exudation.

The ophthalmoscopic appearance is as variable as in retrobulbar neuritis.

The acuity of vision may be normal, or considerably disturbed, depending upon the amount of morbid change and the resulting compression of the nerve.

*Causes.*—Tubercular, syphilitic, or suppurative meningitis, the inflammatory action extending to the nerve sheaths through continuity of tissue. In the latter disease, fibrinous exudation is found in the sub-vaginal space.

*Diagnosis.*—Not only the ophthalmoscopic picture, which often is negative, but there will usually be pupillary asymmetry, and impaired action of the ocular muscles, as well as the general constitutional disturbances,

*Prognosis.*—On account of the usual exciting causes, guarded, as in many instances descending atrophy of the optic nerve will result.

*Treatment.*—Prompt attention to the exciting cause will afford the only hope for good results.

ATROPHY OF THE OPTIC NERVE (Neuritic Atrophy, Papillitic Atrophy).—Different varieties of atrophy are described, as *primary*, *secondary*, *consecutive* (neuritic or post-papillitic), *retinal* and *choroiditic*. The last being forms of consecutive atrophy (DeSchweinitz). Atrophy of the nerve and papilla always follows inflammation of the supporting connective tissue. A more or less constant line of symptoms are present in this condition, although the clinical types will present variations.

OPHTHALMOSCOPIC CHANGES.—CHANGE IN THE DISK.—The color varies from a light gray to white, gradations in color are often noticeable, as a reddish or greenish tint. The variations from the normal are often only perceptible to the experienced observer, and both the direct and indirect methods should be employed with a varying intensity of illumination.

The center of the papilla may be but slightly depressed, or the entire surface may be excavated, depending upon the



amount of nerve fiber degeneration which has occurred. If a physiological depression be present, it will further modify the form. A mottled appearance of the lamina cribrosa may show at the bottom of the excavation, but is not uniformly present.

The margin of the disk is usually very distinct in complete atrophy, but when the atrophy has been preceded by neuritis or retinitis, partial obscuration may be present for some time. Whenever the scleral ring is broadened it always is an indication of atrophy of the nerve head. A broad scleral ring will often be seen in the early stages of spinal atrophy. In these cases there will also be a change in the color of the disk, and contraction of the red and green color fields.

CHANGES IN THE VESSELS.—In neuritic (consecutive) atrophy, the arteries are contracted and the veins appear larger by contrast. White bands along the vessels may be seen in many of these cases. In simple atrophy there may be no change in the vessels, but contraction of the arteries may occur. Retinitic and choroiditic atrophy will show very marked contraction of the retinal vessels and diminution in their number.

The fundus of the eye will show no characteristic changes in simple gray and white atrophy. Following papillitis or retinitic atrophy, degenerated areas indicating the sites of former hemorrhages, and pigment masses are generally found.

Independently of the ophthalmoscopic changes there will be change in central vision. This varies from a slight diminution to blindness. When the morbid process is bilateral, one side is more affected than the other.

CHANGE IN PERIPHERAL VISION.—There may be regular or irregular contraction, hemianopsia and central scotoma. A concentric contraction does not indicate positively the cause of the atrophy. When the macular bundles are

affected, central scotoma results. The temporal field is more defective in spinal atrophy.

COLOR FIELD.—The field for colors is always defective. The green field is usually first contracted, then the red, blue and yellow successively. Exceptions to this rule are not infrequent.

Central color vision may be confused or disturbed in the same way. Color changes are usually much more marked than for form (the white field).

PUPILLARY CHANGES.—This will depend upon the extent of the degeneration. More or less paralytic mydriasis is present, and when complete atrophy has occurred, the pupil is fully dilated and the iris immobile. In some cases the act of convergence will cause pupillary contraction, even when light stimulation fails to produce any change. When only one side of the nerve is atrophied, reaction occurs only when the light is projected upon the unaffected portion of the retina.

The importance of making a careful diagnosis by exclusion cannot be too strongly insisted upon. It is often impossible to make a certain diagnosis by the ophthalmoscopic appearance of the papilla alone.

PRIMARY ATROPHY (also termed gray, progressive, spinal and tabetic atrophy).—Usually both eyes are affected, but not to the same extent. In the early stages the disk may show a superficial capillarity, which gives a red tinge, but the deeper layers are gray. The scleral ring may be somewhat hazy. As the atrophy progresses, pallor of the nerve head is marked, the scleral ring broad and clearly defined.

When the atrophic stage is fully developed, the disk will be gray or white, with at times a bluish or greenish tinge and with a translucent appearance. The lamina cribrosa is usually plainly discernible and the excavation, if present, is complete. The arteries may be contracted, or all the vessels may appear of normal caliber.



**SECONDARY ATROPHY.**—The appearance of the disk is usually similar to that of primary atrophy, although a more decidedly white color is often seen. The retinal vessels may be contracted, the arteries usually the most.

**CONSECUTIVE ATROPHY.**—1. **POST-PAPILLITIC ATROPHY.**—In this type, the colors of the nerve already described are seen much accentuated, but the translucent appearance of the disk found in the primary form is lacking, and the lamina cribrosa cannot be seen. Slight haziness of the disk margin is present, and there is a thickening of the perivascular lymph sheaths. There is contraction of the arteries, and the veins are often decidedly tortuous. Change in the retino-choroidal tissues is also often present.

2. **RETINITIC AND CHOROIDITIC ATROPHY.**—This form results from severe retinitis and choroiditis. The disk is yellow and somewhat waxy looking, the borders ill defined, and the vessels often very much contracted.

*Causes.*—Atrophy results from inflammation of the nerve, choroid and retina, embolism and thrombosis of the central retinal vessels, and in addition, posterior spinal sclerosis, lateral sclerosis, insular sclerosis, and the general paralysis of the insane, when gray degeneration of the optic nerve occurs. The cases showing gray degeneration in posterior spinal sclerosis vary, but are estimated at from 25 per cent. to 35 per cent. The change usually begins in the pre-ataxic stage.

Primary atrophy has been reported as resulting from cold, mal-nutrition, and excessive menstrual disturbances. In some cases it also seems to be produced by syphilis, toxic action of some drugs, diabetes and chronic malaria.

**HEREDITARY OPTIC NERVE ATROPHY.**—Leber describes a peculiar hereditary type, the male members appearing to be the sufferers, although the tendency may be transmitted by the female. The average age of twenty appears to be the favorite time for its appearance, although it has been seen as early as five years, and as late as the forty-third

year. Norris describes three stages: (1) congestion of the disk and edema; (2) gray discoloration of the papilla; (3) pronounced atrophy. Central scotoma is usually found. In quite a number of cases no cause can be assigned for optic atrophy.

Secondary atrophy may result from any condition producing compression of the optic nerve tract, or the chiasm. Distention of the lateral ventricles, the pressure of a tumor, aneurism, or exostosis pressing upon the chiasm. Obstruction at the optic foramen may be a cause, and meningitis has been said to produce it. Injuries about the head, even without bony fracture, have been followed by atrophy.

*Diagnosis.*—A careful consideration of the symptoms described, and a methodical examination of the eye by the different methods, with as complete a history of the patient as possible, will be necessary to avoid error in diagnosis. Under the appropriate headings will be found descriptions of the various physiological and morbid appearances of the papilla.

*Course.*—The disease is essentially chronic, months or even years may elapse before the disease becomes stationary. The cause will usually have an influence on its rapidity.

*Prognosis.*—In the primary form it is unfavorable, as the morbid change continues as a rule until blindness results. In consecutive atrophy the prognosis should be guarded, as the resulting vision will depend upon the extent of shrinking of the tissues following the neuritis. In atrophy of the axis of the nerve, the best results are generally obtained. All conditions must be considered in making a prognosis, and the more careful and complete the examination, the better prepared one will be to give a valuable opinion.

*Treatment.*—The cause of the disease will influence the treatment, but unfortunately in the majority of cases but little can be done.

In ataxic cases the use of nitrate of silver in doses of grs.  $\frac{1}{8}$  to  $\frac{1}{4}$  four times a day for two weeks, then allowing an



interval of one or two weeks, again repeating. Argyria is less liable to occur when the drug is given in this way. Ergot in doses of gr. xv to xx four times a day have given good results in several cases, rapid relief from the tabetic symptoms being followed by visual improvement. Belladonna in some of the cases will also give good results. When the pain in the back is severe and the visual disturbances are considerably increased, codeine has appeared to have a beneficial effect.

In syphilitic cases iodide of potassium. Mercury should seldom be used in these cases, and when it is, extreme caution should be observed, as the drug will tend to hasten atrophy as a rule. Phosphorus, dilute phosphoric acid, arsenic, and iodide of arsenic have also been employed with good results when the indications for the drugs were present. The different forms of electricity have been used, but the results have not been gratifying in most instances. Nuxvomica has been employed, but in tabetic cases the use of drugs which increase the flow of blood to the affected area will aggravate the disease.

**INJURY OF THE OPTIC NERVE.**—This may result from penetrating wounds of the orbit. Fracture of the orbital plates or base of the skull may also injure the nerve, and atrophy will always follow when the nerve is injured.

**TUMORS OF THE OPTIC NERVE.**—Tumors of the nerve very seldom occur, but when they do, they may assume any of the forms of tumors. Primary tumors of the nerve are most frequently seen in children, and as a rule are benign. No age seems exempt, however.

*Symptoms.*—Exophthalmos is usually the first symptom noticed, the eye protruding forward and somewhat outwards and downwards. The limitation of motion of the ball depends upon the amount of displacement. Vision is early affected and may result in complete blindness. The progress of the growth is slow and usually painless. The ophthalmoscopic picture reveals distended veins, disk red-

dened and edematous, later atrophy of the nerve and shrunken veins.

*Treatment.*—Early removal of the tumor promises the best results. Enucleation of the eye is necessary as a rule. Exenteration of the orbit has been performed in four cases. (DeSchweinitz.)

**HYALINE BODIES IN THE PAPILLA** (Colloid Bodies, Verrucosities, Drusen).—These are occasionally found in young persons whose eyes in other respects are normal. Where there has been an optic neuritis, pigmentary, or albuminuric retinitis, they are also sometimes seen. Usually they are separated, lustrous, pearly, spherical bodies, but may be numerous and confluent. When they are deep in the nerve tissue it is often difficult to recognize them.

They may entirely cover the margin of the disk, and also the disk itself, with a mulberry like-mass. The blood-vessels may be seen at the center or side of the disk. The bodies usually encroach upon the retina, sometimes extending quite a distance. One or both eyes may be affected.

The granules consist of hyaline substance, which may show points with a tendency to calcareous degeneration.

*Diagnosis.*—When the bodies are few and deeply seated, the condition may be easily overlooked. In pronounced cases the diagnosis is easily made, although it has been mistaken for optic neuritis, but a careful examination should eliminate such an error.

*Prognosis.*—Good as far as vision is concerned, as unless other marked fundus changes are present, visual disturbances are slight if any.

*Treatment.*—So far as known no treatment has had any influence on this disease.



## CHAPTER XV.

### AMBLYOPIA, AMAUROSIS, AND VISUAL DISTURBANCES WITHOUT OPHTHALMOSCOPIC CHANGES.

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The terms *amblyopia* and *amaurosis* both mean dimness of vision, the former term denoting obscurity of vision and the latter loss of vision. The two terms are often used synonymously and are generally supposed to designate visual defects without visible changes, but sometimes the term *amaurotic* is employed to describe eyes blinded by inflammatory diseases.

Amblyopia should be regarded as a descriptive symptom of defective vision, without sufficient ophthalmoscopic changes to account for the defect.

CONGENITAL AMBLYOPIA.—These cases usually have defective vision without any perceptible lesions of the fundus, but an abnormal disk may be seen in some cases, and variable sized scotomas may be present, especially for colors. Hyperopia and astigmatism are nearly always very marked. Correction of refractive errors, while it may improve the vision, will usually fail to give good visual acuity. Careful correction however, should be given, as at times improvement will occur, whether the result of stimulation of the retinal elements, the nerve fibers, or an increased development of the visual centers of the brain, it is impossible to state.

*Amblyopia ex anopsia* is a term used for defective vision supposed to result from disuse of the eye. This may occur in cases of congenital cataract, corneal opacities, or with an

impervious persisting pupillary membrane, and in an eye which has turned from infancy. The amblyopic eye may improve if the fellow eye becomes blind or is lost.

In two cases, one a man of thirty-eight, the other of twenty-two, by carefully correcting the refractive errors, and covering the good eye two or three times a day, improvement followed, in the first case from 1-200 without a glass to 20-80. The second case whose vision was 5-200 at first examination, after fitting with a correcting lens, in three years had improved to 20-30, and read Jaeger No. 2 without difficulty. At the time of the first examination he could not see Jaeger type at all.

In some instances a low grade of choroido-retinitis in the macular region brought on by irritating stimulation may be the cause of an amblyopia. (Gould.)

Coloboma of the iris, and microphthalmos are congenital defects which may also produce amblyopia. Retinal hemorrhages in the newly born would account for some cases. In albinism, amblyopia is present. Nystagmus is usually present when both eyes are amblyopic, but when only one is affected, the affected eye may turn.

CONGENITAL COLOR AMBLYOPIA.—Color blindness. Defective color sensation has been found in about three per cent. of the cases examined, the majority being males. Only about 0.2 per cent. being found in females. Both eyes are affected, excepting in rare instances, and heredity appears to be a factor.

All of the functions of the eyes, excepting for colors may be normal, and in these cases no abnormal defects have been discovered. The anomalous condition has been divided into *achromatopsia*, inability to perceive colors, partial color blindness being the rule, and one or more of the primary colors can be distinguished. *Dyschromatopsia*, when there is a difficulty in recognizing colors, although the primary colors may be distinguished, but the gradations are undetected. Various theories have been advanced to account



for color blindness, the ones most generally accepted being the Young-Helmholtz and the Hering. The former of these theories recognizes three primary colors, red, green, and violet, and holds that there are three sets of nerve terminals in the retina, or a division of the rods and cones which respond to the stimulation of these colors. The shades being produced by the light stimulus affecting the divisions to a greater or less extent. White results when all the elements are stimulated equally.

The stimulation imparted by the longer color waves, as at the red end of the spectrum, will produce but little change in the nervous elements which are supposed to receive the shorter waves, violet. The same rule holds true when the light waves are short. An orange color produces considerable stimulation in the red terminals, also in the green, and but little in the violet. In the brain are corresponding sets of ganglion cells, which are in direct communication with the retinal elements through the nerve. This theory is the one most generally accepted.

The Hering theory recognizes six primary color sensations, which are arranged in pairs of antagonistic or complementary colors, black and white, red and green, yellow and blue. These colors are recognized either through dissimulation or assimilation of the visual substance. Changes produced in the visual substance in the retina depending upon the stimulation are perceived by the brain as color sensations.

Both of these theories are founded upon the supposition that the defect is in the eye itself, or rather of some of the receptive elements.

Investigations have failed to show any abnormal condition in the eye, and it is a question whether the defect is not in the visual centers, rather than of the receptive portion. The number holding this view is in the minority. The prevalence of color blindness in the male, and the very low percentage in the female, would make it appear plausible that education of the color sense was a factor. It is a well known

fact that the ability to estimate distance, size, and form of objects only comes after considerable experience. This may be said of any of the special senses. It is a matter of education, and this cannot occur without development in the analytical portion of the brain. It is a well recognized fact that all of the special senses are simply modifications of the universal sense of touch, developed from the same embryological tissue, and it would seem to be a rational explanation that cerebral defects should be present in color blindness rather than that there exists an abnormal condition of the receptive portion of the eye.

**REFLEX AMBLYOPIA.**—Many reflex causes have been assigned for some amblyopic cases, but as a rule have proven erroneous. Irritation of some of the branches of the fifth nerve, especially from defective teeth, have caused amblyopia. Intestinal parasites, and naso-pharyngeal diseases have produced amblyopia.

**TRAUMATIC AMBLYOPIA.**—Injuries of the occipital portion of the head, blows upon the forehead, especially in the region of the supra-orbital nerve, and injuries of the spinal cord may produce amblyopia. A fracture involving the optic canal, hemorrhage into the cranial cavity, disturbance or disorganization of the cerebral cortex, with secondary changes in the nerve, are factors in some cases.

An ophthalmoscopic examination may be negative. The amblyopia may be temporary, but if effusion or extravasation have occurred into the intervaginal space of the optic nerve, it may be permanent.

After railroad accidents an excessive amblyopia is often developed by the victims, which may be permanent until a verdict has been rendered by the jury.

*Treatment.*—Rest will be an important element in the treatment of these cases. Nux vomica, dilute phosphoric acid or phosphorus may be beneficial.

Amblyopia and amaurosis may also result from some general diseases and the toxic action of many drugs, either



through direct influence upon the retina, the visual centers, or possibly vaso-motor disturbances affecting the circulation to these structures. Clinical divisions are :

**UREMIC AMBLYOPIA OR AMAUROSIS.**—This is quite common in pregnancy and scarlet fever. In the latter disease it is associated with albuminuria in the desquamative stage. Both eyes are affected, and not infrequently total blindness occurs, accompanied by brain symptoms, vomiting, convulsions, stupor, coma and hemiplegia. Pupillary reaction may not be absent in these cases.

In pregnancy the disease is usually one of the later manifestations, appearing near the close of gestation.

The ophthalmoscope may reveal nothing, or a slight neuritis, or a woolly appearance of the disk may be present.

*Prognosis.*—Usually good as far as vision is concerned.

*Treatment.*—Directed entirely to the exciting cause.

**GLYCOSURIC AMBLYOPIA.**—Besides diabetic cataract or retinal hemorrhages, an amblyopia may develop without any special fundus changes.

The visual field may be normal, or it may be peripherally contracted. Sometimes hemianopsia, but color scotoma is always present, and frequently in those cases who are abstainers from the use of alcohol and tobacco. When color scotomas are present, a careful analysis of the urine should always be made for sugar, even in cases of excessive tobacco users.

*Prognosis.*—Very unfavorable.

*Treatment.*—Directed to the diabetic condition.

**MALARIAL AMBLYOPIA.**—In many cases no lesions of the fundus are present, but transient loss of vision, or total blindness, lasting for variable periods, possibly months, have been seen. The malarial poison appears to have an influence upon the optic nerve and retina. The action of quinine in producing temporary amblyopia must be remembered. One or both eyes may be affected.

*Prognosis.*—Usually good.

*Treatment.*—Quinine, unless the patient's system has already been overloaded, arsenic, gelsemium, or whatever remedy may be indicated.

AMBLYOPIA FROM LOSS OF BLOOD.—Spontaneous hemorrhages more often produce this condition than traumatic. Hemorrhages from the stomach or bowels are credited with producing the most complete amblyopia. The amblyopic condition may be temporary on account of diminished blood supply, or permanent blindness and optic nerve atrophy may result. Excessive uterine hemorrhages may also at times produce transient amblyopia.

The ophthalmoscopic examination will show all grades of anemia, from a slight paleness to an atrophic whiteness of the disk, and the arteries are contracted. In the most unfavorable cases the lesions often cannot be seen until after a week or two. Retinal hemorrhages and neuritis may follow.

*Prognosis.*—Most favorable following uterine hemorrhages, less so in stomachic hemorrhages.

*Treatment.*—Rest. Proper hygienic conditions, easily digested food. Nux vomica, ignatia, arsenic, dilute phosphoric acid, or any other remedies required by the condition of the tissues.

DRUG AMBLYOPIA.—The list of drugs which may produce amblyopia is so large that but a few will be mentioned. Amblyopia may result from the toxic effects of male fern, iodoform, cannabis indica, alcohol, nitrate of silver, tobacco, salicylic acid, ergot, osmic acid, cocaine, mercury, bisulphide of carbon, santonine, stramonium, ptomaines, carbolic acid, salts of lead, nitro-benzol, chloral, quinine, coal tar products, and many others.

Lead and its salts may induce a neuritis, but amblyopia without ophthalmoscopic changes has been seen. The condition without a neuritis is generally transient.

Quinine amblyopia only follows the administration of large quantities of the drug as a rule, but DeSchweinitz re-



ports one case, a susceptible and neurotic woman, who showed decided temporary amblyopia when but twelve grains of the drug were administered. In this form of amblyopia complete blindness follows the ingestion of the drug, the papilla showing extreme pallor, and the retinal vessels are diminished in size and number.

When the amblyopia is not so pronounced, there will be contraction of the visual field. Other symptoms which are sometimes present are, color and light senses diminished, and during the blind stage the pupils dilated and the iris immobile, while corneal anesthesia has been noticed in some cases. The primary effect of toxic doses of quinine is to diminish the blood supply to the retina and optic nerve, this is accomplished through spasm of the vessels.

Central vision may or may not be fully restored. The visual field gradually increases, but does not regain its normal. Pallor of the disk may remain for years. Gruening reports one case where the macula contained a cherry-colored spot, and a scotoma in the visual field of another.

The treatment of this form consists in avoidance of the further use of the drug. Inhalations of nitrite of amyl, and the administration of nux vomica, or strychnine, digitalis, gelsemium, etc., the object being to use such measures as will improve the eliminative powers of the system.

**AMBLYOPIA FROM TOBACCO AND ALCOHOL.**—Tobacco, alcohol, and tobacco-alcoholic amblyopia constitutes the most prevalent type of this condition. Either one of the two may produce amblyopia, but the two toxic agents are generally associated. Appears most frequently after the age of forty.

*Symptoms.* The patients complain of a misty or smoky medium between them and the object. The ability to do close work is impaired, and relief is sought by adopting or changing reading glasses. Visual acuity diminishes, until both distance and near vision are practically abolished. The ability to distinguish red and green is lost, horizontally

oval, central negative scotomas are found by the use of the perimeter. Day blindness is present as a rule.

Ophthalmoscopic changes are not always present, but hyperemia of the disk is often seen during the early stages, and in the later stages, in the temporal portion of the disk, corresponding to the macular nerve fiber bundles, may be seen a triangular atrophic spot.

*Diagnosis.*—The line of symptoms given, as well as the history of the patient will usually be sufficient.

*Prognosis.*—Usually good, when the patient will abstain from the use of the exciting cause.

*Treatment.*—Hot or Turkish baths, and hygienic measures. Nux vomica, or jaborandi.

PTOMAIN POISONING.—The poisonous alkaloids found in tainted meat, cheese and sometimes in ice-cream may produce amblyopia.

*Symptoms.*—Similar to belladonna poisoning. Mydriasis and temporary dimness of vision. Ptosis is often found, and the action of the external ocular muscles is lessened or destroyed. Ophthalmoscopic changes do not appear.

*Treatment.*—Removal of the exciting cause when possible and the employment of measures to save the life of the victim.

HYSTERICAL AMBLYOPIA.—This form of blindness occurs in both sexes, but is more frequently found in young women. Complete loss of vision, but with a prompt pupillary change to light when the sound eye is covered, will usually be found.

Ophthalmoscopic examination shows a normal fundus. Most frequently it can be proven that vision is present in the supposedly blind eye. Achromatopsia, or dyschromatopsia, contraction of the visual field and hemianesthesia are symptoms often also additionally present. Hemianopsia, and infrequently scotoma may also be present.

The visual defect sometimes is that of *crossed amblyopia*, i. e., complete or partial blindness on the side of the hemi-



anesthesia, and a defect of visual acuity upon the opposite side.

Partial or complete color blindness may be present, and a more or less reversal of the normal order is sometimes found. As is to be expected, hysterical subjects will usually show other symptoms. Blepharospasm, ptosis, monocular diplopia, conjugate deviation of the eyes, etc. The limitation of symptoms shown being proportionate to the intelligence of the patient.

*Prognosis.*—Usually favorable, but a considerable time may be required to effect a cure.

*Treatment.*—Avoidance of mental or physical fatigue; a change of scene is often beneficial. Suggestion is important in these cases. Pulsatilla, valerianate of zinc, arsenic; in fact the cause of the hysteria should receive attention.

**SIMULATED AMBLYOPIA** (Simulated Blindness, Malingering).—Persons often feign blindness of one or both eyes for various reasons; it may be for sympathy, to escape work, etc., and not infrequently for obtaining heavy damages for supposed injuries.

Various methods for detecting the deception have been employed. In all examinations for detecting feigned blindness the examiner should be in a position to watch both eyes closely, in order to prevent the patient from closing first one then the other eye, in order to find what character of test is being made.

**HARLAN'S TEST.**—In a trial frame, place before the supposed sound eye a +16.00 D. lens, and before the affected eye a -0.25 D. lens, and have the patient look at the distance card. If able to read the letters on the card, it of necessity is done with the eye claimed to be blind, as it would be impossible to read the letters with the sound eye with a +16.00 D. lens.

Java tests these cases by successively interposing between the sound eye and the reading type, a pencil or rule; if the patient continues reading correctly it shows that

the diseased eye is being used. In this test absolute immobility of the patient's head and also of the reading card must be obtained.

Welz' plan is by employing a prism of six or eight degrees base out, placed before the bad eye. If binocular vision is present, the sound eye will turn inward to fuse the image, becoming straight again when the prism is removed. This is never found where there is absence of binocular vision.

Many other methods are employed, but these should be sufficient to place one on his guard, respecting the case.

When both eyes are claimed to be blind, it is much more difficult to expose the falsity of the claim. Pupillary reaction to light is not conclusive evidence of malingering, as this may occur in many cases where the eyes are blind. A test for feigned blindness in both eyes, suggested by Priestley Smith and E. Jackson, is to place a lighted candle before the patient, then placing a six degree prism base out before one eye; if vision is present in both eyes the eye behind the prism will turn inward, and when the prism is removed will move outward, the other eye not moving.

It is very important that the examiner be so placed as to watch the movement of the eyes carefully in these cases.

**NIGHT-BLINDNESS (Functional Night-Blindness).**—In this condition there are no retinal lesions. It is a functional disturbance where from some cause the sensibility of the retina is diminished, or the adaptive power of the retina is imperfect.\*

Exposure of the eyes to intense light seems to be a cause in some cases. Scorbutic persons or a debilitated condition of the system appears to have an influence in producing this symptom. People in tropical countries seem to be the most subject to night blindness. It has also been observed in

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\*The two terms nyctalopia and hemeralopia are both employed to designate either night blindness or day blindness, and the various authorities differ regarding their application. Nyctalopia is most frequently used for night blindness, however



large schools, especially in the spring and early summer. (Nettleship, Snell.) In Russia during Lenten fasts it has appeared to be endemic. In xerosis of the conjunctiva it is not an uncommon symptom.

In a bright light the vision may be normal, but on dark days, at twilight and at night, the acuity is much diminished, often being so marked that the patient cannot move about without assistance.

*Treatment.*—If due to bright light the eyes should be protected by dark glasses. If mal-nutrition appears to be a factor this should be overcome, but in the majority of cases treatment is of no avail.

DAY BLINDNESS.—(*See note under night blindness.*) Those who see better in a subdued or dim light, while in a bright light vision is defective, are termed day blind. Irregular contraction of the field of vision is seldom present. In retinitis nyctalopia, as described by Arlt, and with the chronic types of orbital neuritis, it is sometimes found. It may be in other optic nerve diseases as well as in some retinal affections.

In irideremia, albinism and iris coloboma, it may be present. In some cases it may be a congenital defect associated with an amblyopia. Occasionally it develops idiosyncratically without any known cause, and persons who have been working in a dim light, or who have been confined in dark places may show this condition.

*Prognosis.*—If acquired it may be relieved, but if congenital little can be promised.

*Treatment.*—Measures to restore the system to a normal condition, and gradually accustoming the eyes to ordinary light.

SNOW BLINDNESS.—This is not often seen excepting among persons who live in high altitudes or latitudes.

*Symptoms.*—Conjunctivitis and sometimes chemosis. A burning sensation of the eyes and lids, lachrymation, photophobia and blepharospasm. In aggravated cases ulceration

of the cornea sometimes occurs, the pupils are contracted, and by the ophthalmoscope, the retina will be found hyperemic. Acuity of vision may or may not be affected, unless the cornea is implicated or scotomas are present.

Analogous symptoms are found in persons exposed to the glare of the arc light or electric furnaces, *electric ophthalmia*.

*Prognosis*.—Usually good, although the intolerance to light and the conjunctivitis may continue for some time.

*Treatment*.—Rest of the eyes in a moderate light, mydriatics and the use of the hydrastis collyrium will usually be sufficient.

**ERYTHROPSIA (Red Vision).**—Colored circles of light have been described under glaucoma. In patients who are totally blind there is occasionally a complaint of colored lights, evidently resulting from some irritation of the visual centers. Red vision sometimes occurs after cataract operations. Santonine poisoning has also produced it, but it may induce yellow vision (*xanthopsia*). In atrophy of the optic nerve, red vision is often noticed, *Kyanopsia*, or blue vision, is a very rare condition, and is described by Burnett as occurring in persons with amber colored cataracts. Colored vision as a rule is usually transient.

*Treatment*.—The bromides, pulsatilla and gelsemium.



## CHAPTER XVI.

### AMBLYOPIA OF THE VISUAL FIELD, SCOTOMAS, HEMIANOPSIA.

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In order to positively differentiate many diseases of the eye the use of the perimeter is necessary. Besides the changes noted in glaucoma, retinitis, choroiditis and optic nerve lesions, there are other visual defects which are important in making a diagnosis.

**CONTRACTION OF THE FIELD.**—Contraction of the field may be concentric (regular), eccentric (irregular), or sectoral. In homonymous hemianopsia, the halves of the fields are symmetrically defective, and results from intracranial lesions. The contractions result from local or central lesions.

**SCOTOMAS.**—Blind spots or scotomata may appear in both eyes. A scotoma may be positive or negative; if positive it is distinguished as a dark (relative) or black (absolute) scotoma. When negative, it develops during the examination, not being recognized at first. The physiological blind spot, or blind spot of Mariotte, is a typical example of a negative scotoma.

Scotoma may be located in any portion of the field, and may be single or multiple.

Scotoma may result from opacities or foreign bodies in the refractive media, which would also include hemorrhages or injuries of the eye through traumatism. Any lesion destroying the functions of a portion of the visual area will produce scotoma.

The causes which produce this are usually divided according to location. Partial embolism of the central retinal artery, or a thrombosis, will produce marked changes in the visual field, usually central. A foreign body will produce a scotoma at its location. Retinal degeneration through any cause will also show limitations of the field. Malnutrition of the retina and choroid, and hemorrhagic retinitis may produce scotomas or irregular contraction. Albuminuric, circinate, and diabetic retinitis form central scotomas and in the later stages, amblyopia or amaurosis with contraction of the field. Retinitis pigmentosa ordinarily produces very marked contraction of the field and amblyopia.

CHOROIDITIS.—Changes in the nutrition and circulation of the choroid will be followed by scotomas. Coloboma may cause a scotoma and will show a sectoral defect. Hemorrhage, rupture, or tumor will produce scotomas proportionate to the extent of the lesion. In exudative choroiditis multiple scotomas are frequent and are relative or absolute. When they become confluent, the size of the defect is increased and may assume the form of a ring. Contraction of the visual field usually occurs. When the macular region is affected, the scotomas will be central. The posterior staphyloma of myopia may be of such a size that the normal blind spot will be considerably enlarged. In senile atrophy both central scotoma, contraction of the fields and amblyopia may result.

GLAUCOMA.—The different types of contraction have been described.

OPTIC NERVE.—In coloboma of the nerve and sheath there is increased size of the blind spot. Sectoral defects are generally found in injuries and tumors of the nerve, with contraction of the field and amblyopia. In papillary diseases, the change will depend upon the amount of tissue implicated the blind spot being usually increased in size. Atrophy of the nerve generally results, when contraction or sectoral defects and scotomas are found.

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Central scotoma usually follows a retro-bulbar neuro-retinitis, and also in toxic amblyopia.

**OPTIC NERVE ATROPHY.**—Sclerotic changes of the optic nerve may cause amblyopia, as well as posterior spinal sclerosis. The color fields usually show more contraction than that for form. Scotomas are often present.

In stationary nerve atrophy, there may be no further changes in the visual acuity, but complete blindness may result when the process continues, (progressive atrophy of the optic nerve).

Hereditary atrophy is a form which usually makes its appearance between the ages of twenty and thirty, and scotomas are present.

**INTRA-CRANIAL DISEASES.**—Hemianopsia or Hemiopia. This condition has been described.

**PUPILLARY REACTION.**—Of especial diagnostic importance in brain lesions, particularly when associated with eye symptoms, are the pupils. Consensual reaction to light is the normal condition when the stimulus is directed to either eye.

The method of conducting the examination is important. The patient should be in a darkened room, with the light placed in such a position that no direct rays fall upon the eyes. Then directing a weak light from a plain mirror onto the retina, throwing the light obliquely, and watching the pupils, will show whether there are insensitive retinal areas. The light from a concave mirror may be used in a similar manner, being careful that diffuse light is not thrown over the retina.

In hemianopsia, if the light thrown upon either the defective or normal side of the retina causes contraction of the pupil, it will show that the lesion is back of the primary optical centers. When contraction of the pupil does not follow when the light falls upon the defective portion of the retina, but contracts when light is directed upon the

normal side, the lesion is in front of the primary optical centers. In the first case there is no disturbance of the sensory motor arc of the pupils; in the latter the lesions interfere with this arc, and the term *hemianopic pupillary inaction* is employed, or as it is often called, *Wernicke's symptom*. The prognosis in such cases depends upon the cause of the lesion, and also whether it is amenable to treatment.

MONOCULAR HEMIANOPSIA.—Besides the forms of amblyopia given under hemianopsia, there is a condition in which but one eye is affected. The supposition being, that a part only of the fibers of one tract are involved.

PARTIAL FUGACIOUS AMAUROSIS (Flickering Scotoma).—This is a temporary blindness, beginning usually in the center of the field of each eye, and increasing until the entire field is affected. Vertigo and occasionally defects of speech or memory may be associated with it. Vibrating spots or shadows are complained of. Headache and vomiting follow the attack, when the blindness subsides.

*Causes*.—Disturbances of cerebral circulation is probably the cause. It has also been noted in syphilitic cases.

*Prognosis*.—Depends upon the cause, as at times a serious lesion of the brain may be present.

*Treatment*.—This should be directed to the restoration of normal circulation, if possible. Belladonna, ergot, gelsemium cactus, strophanthus, etc. If syphilis appears to be a factor the use of the proper remedies as indicated.

RETINAL ANESTHESIA (Amblyopia of the Visual Field).—This has already been given. See page 287.

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## CHAPTER XVII.

### DISEASES OF THE ORBIT.

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#### ANATOMY.

The orbit consists of bony walls which vary in strength according to the position. The shape of the orbits are described as pyramids or truncated cones, the base being forward and outward, and quadrilateral in form. The upper margin is formed by the frontal bone. The frontal sinus usually produces a prominence at the upper inner angle, while the upper external angle is marked by the junction of the ascending process of the malar with the frontal. The supra-orbital foramen, or notch, is located near the junction of the middle and inner third of the superior margin.

The outer border and the external half of the lower border are formed by the malar, and presents a sharp orbital edge. Continuous with this is the sharp ridge of the superior maxillary which forms the inner half of the lower border and extends upwards to the internal angular process of the frontal, forming the inner margin of the orbit. The sharp edge disappears on the inner side a little below this junction. The anterior border of the lacrimal canal is formed by the sharp edge of the inner margin.

The angles of the orbital walls are rounded, so that the pyramidal appearance is not so marked as that of the base.

The inner walls of the orbits are nearly parallel, but the axes of the orbits run outwards and downwards. The roof of the orbit passes backwards, in nearly a horizontal plane, but is slightly concave. In front it is formed by the orbital plate of the frontal, and behind by the lesser wing of the

sphenoid. The inner orbital wall is vertical, joining the roof nearly at a right angle, but below gradually curves into the floor. The bones forming the inner wall are, from before backwards, the nasal process of the superior maxillary, the lachrymal bone, the orbital plate of the ethmoid, which constitutes the greater portion and posteriorly a small portion of the sphenoid body. The posterior portion of the lachrymal bone is in the same plane as the ethmoid, but the anterior part, separated from the other by a ridge, forms with the ascending process of the superior maxillary the lachrymal groove or canal.

Situated between the ethmoid and frontal bones are the anterior and posterior ethmoidal foramina. The inner wall for the most part is extremely thin, and tumors on either side find little resistance from this structure.

The floor of the orbit which slopes downward and outward is formed mostly by the orbital surface of the superior maxillary, the palatal forming a small triangular portion near the apex, and the orbital process of the malar forming a portion at the outer anterior angle. Externally and occupying the posterior two-thirds, is the sphenomaxillary fissure, which opens into the zygomatic fossa.

The outer wall consists of the malar anteriorly, and the greater wing of the sphenoid posteriorly.

The sphenoidal fissure which runs upwards and outwards, is situated near the back of the orbit between the greater and lesser wings of the sphenoid. Near the lower end of this fissure is the apex of the orbit, which opens into the middle fossa of the skull and transmits the ophthalmic vein and the orbital nerves, excepting one or two small branches from the second division of the fifth pair. A little external to this foramen is a spinous process to which a part of the external rectus muscle is attached. A little above and external to the inner end of this fissure, and located in the lesser wing of the sphenoid, is the opening of the optic foramen, a short canal which transmits the optic nerve and



ophthalmic artery. The optic nerve passes in curves from the optic foramen downwards and outwards to the eyeball.

The orbital muscles are the levator palpebræ superioris, the external, superior, internal and inferior recti, and the superior and inferior oblique. With the exception of the inferior oblique, these muscles all start near the optic foramen. The foramen and inner part of the sphenoidal fissure

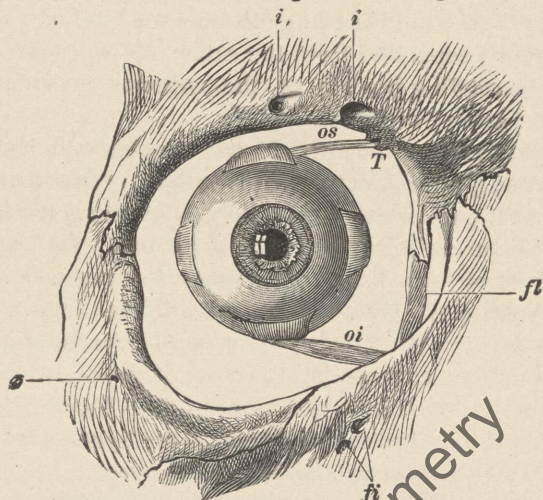


FIG. 90.—Anterior Orifice of the Orbit, with the Eyeball. Natural size. The tendons of the four recti muscles are cut off near their insertion upon the eyeball, but the inferior oblique, *oi*, and tendon, *os*, of the superior oblique are left entire. The latter comes out from the loop of the trochlea, *T*. To the temporal side of the trochlea lies the supra-orbital notch, *i*, and somewhat to the outside of this there is a foramen, *i*, which is not regularly present, for a branch of the supra-orbital nerve. In this case the infra-orbital foramen, *fi*, is also abnormally divided into two distinct foramina. *Z* is the orifice of the zygomatico-facial canal, *fl* the lachrymal fossa. *Fuchs*

are surrounded by a short tendinous tube which furnishes the principal origin of the recti muscles. The external rectus also has an additional attachment to the spine usually found at the outer border of the fissure. The recti muscles

form a cone, inside of which lies the optic nerve and its accompanying vessels, while externally to the cone are the levator and oblique muscles. The muscles are composed of straight parallel fibers with but very little connective tissue. As the muscles pass forwards they become more and more tendinous, and invaginate the capsule of Tenon, passing under the conjunctiva, and are inserted into the sclera at from five to eight millimeters from the cornea.

The muscles vary considerably from each other in strength. The internal rectus is the strongest, and the superior rectus the weakest.

The superior oblique passes along the upper inner part of the orbit, becoming a small round fibrous bundle as it passes through the tendinous pulley, then expanding into tendinous tissue, passes backwards and outwards between the superior rectus and the eyeball to its insertion. The insertion varies, but usually the anterior point is about as far outward as the outer end of the superior rectus, and lies back of the equator of the globe nearly the same distance as the insertion of the superior rectus is in front of it. The line of attachment then usually runs in a curve backward and inward to the nasal side of the meridian.

The inferior oblique has its origin from the floor of the orbit, just inside the opening for the nasal duct. Its structure is distinctly muscular. The muscle passes between the inferior rectus and the floor of the orbit, then curves around the eyeball to its point of insertion at the back of the globe at the outer and inferior portion.

More or less closely investing the eyeball from the optic nerve nearly to the corneal margin is a delicate membrane, Tenon's capsule. This capsule and the conjunctiva merge into a single membrane close to the margin of the cornea. Tenon's capsule encloses a lymph space between it and the eyeball. Connective tissue bands are contained in this space which are very numerous in the posterior portion. This capsule also separates the eyeball from the orbital cushion of fat.



From the fibrous tissue of the sheaths of the ocular muscles, strong expansions are given off, which pass to the adjacent structures, probably giving steadiness to the movements of the eye as well as co-ordinating action to the other tissues.

Bounded anteriorly by Tenon's capsule and the fibrous expansions of the extrinsic muscles, is a cushion of fat filling the orbit. Enclosed within the cone formed by the recti muscles and Tenon's capsule, the fat is delicate and loosely placed, especially around the delicate structures enclosed therein. In some portions of the orbit, as at the lower front part, and around the lachrymal gland, the fat lies in comparatively hard masses. Variations between the two forms are found in different portions of the orbit.

The ophthalmic artery, a branch of the internal carotid, accompanies the optic nerve through the optic foramen, usually below and to the outer side, and enclosed within the dural sheath of the nerve from which it emerges soon after entering the orbit. The artery divides into three divisions, the first of which constitutes the central retinal artery and the ciliary arteries; the second supplies the muscles, lachrymal apparatus, and the lids, as well as the anterior ciliary arteries; the third, the terminal branches and the ethmoid arteries.

Meyer arranges the branches of the ophthalmic artery as: 1, the retinal with the inner ciliary arteries; 2, outer ciliary; 3, lachrymal; 4, superior and external muscular; 5, supra-orbital with the posterior ethmoidal; 6, internal and inferior muscular; 7, anterior ethmoidal; 8, final division into palpebral, frontal and nasal. Variations from this arrangement are frequent.

The orbital veins form a freely anastomosing system with the cavernous sinus, the facial vein, and branches from the internal maxillary.

The superior ophthalmic vein begins at the upper inner angle of the orbit, formed by communicating branches from

VERTICAL SECTION THROUGH THE EYEBALL AND ORBIT IN THE DIRECTION OF THE ORBITAL AXIS, WITH CLOSED EYELIDS.

(Semi-diagrammatic. After Schwalbe, modified to show fasciae.)

Periorbita *green*; muscle-fascia *red*; Tenon's capsule *yellow*.

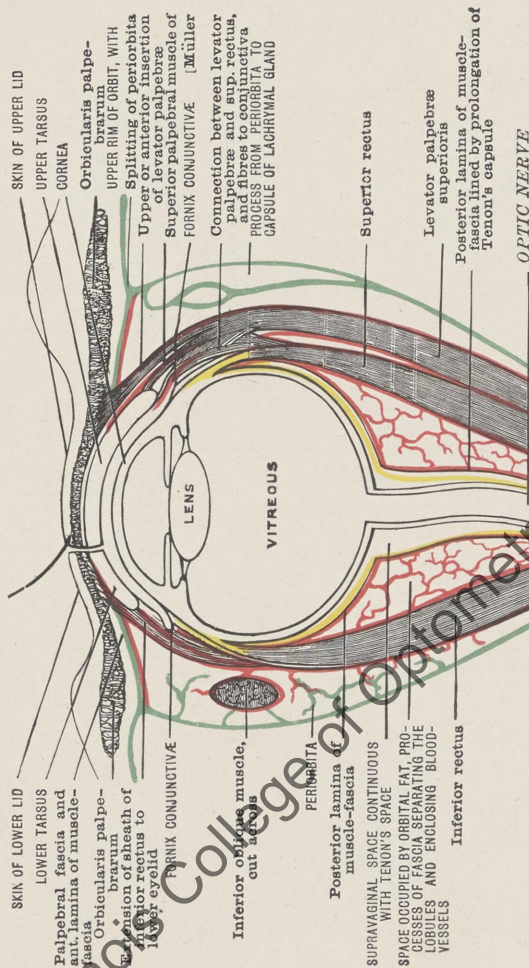


FIG. 91.

(Morris)



the frontal and nasal veins, passes backwards between the optic nerve and superior rectus, through the sphenoidal fissure to the cavernous sinus. The inferior ophthalmic vein, much smaller than the superior, passes backwards near the floor of the orbit, but above the inferior rectus, usually emptying into the cavernous sinus. The venæ vorticosæ pass backwards from the ciliary veins, and may unite with either or both of the ophthalmic veins.

The lymphatic circulation is maintained through both vessels and spaces.

*Nerves.*—The orbital nerves are the third, fourth, and sixth pair, first division of the fifth pair, and some fibers from the sympathetic division from the cavernous plexus.

The nerves enter the orbit through the sphenoidal fissure, the highest and most external being the lachrymal, next the frontal, then the fourth, all passing outside the external rectus. Passing inside the muscular cone is, first, the upper division of the third, a little below this nerve the following nerves enter the eye at about the same level; the nasal, lower division of the third, and the sixth.

The upper division of the third supplies the levator and the superior rectus. The lower division supplies branches to the inferior and internal recti, and a long branch to the superior oblique. The fourth nerve enters the superior oblique, and the sixth nerve supplies the external rectus. The lachrymal nerve supplies the lachrymal gland and gives off branches to the upper lid and part of the conjunctiva. The nasal branch supplies one or two ciliary filaments, also the infra-trochlear nerve which supplies the lachrymal sac, conjunctiva, lids and some areas of the nose; after leaving the orbit it is finally distributed to both the mucous surfaces and integument of the nose.

The *lenticular* ganglion is located about two-thirds of the distance from the ball to the optic foramen, and is on the outer side and close to the optic nerve. The shape and size

of this ganglion is variable. It has a short (motor) root from the third, coming from the branch to the inferior oblique, a long (sensory) root from the nasal, and one or two sympathetic fibers from the cavernous plexus. From this ganglion the short ciliary nerves are given off.

**CONGENITAL ANOMALIES.—ANOPHTHALMOS.**—This is an absence of one or both eyes, usually both. A child born in this condition may present other anomalies or it may be otherwise normal. The lids are generally small and sunken. When the lids are separated the empty orbit is seen. The palpebral fissures are small. This condition seems to result from some disturbance which retards the development of the anterior primary encephalic vesicle.

**CYCLOPIA.**—This anomaly results from the fusion of the orbits and eyes, so that there is but one eye situated where the root of the nose is normally located.

Some cases of monstrosities being born having more than two eyes have been reported, but they are very rare. Either of these conditions results from faulty development in the embryo.

**Symptoms of Orbital Diseases.**—In diseases of the orbit two symptoms are nearly always present. (1) *Exophthalmos* or *proptosis*, protrusion and displacement of the eyeball. (2) Immobility of the eyeball. This may be partial or complete, and if vision is not much impaired, diplopia results on account of the limitation of motion.

Complete immobility in orbital disease is distinguished from the immobility of paralysis of the external ocular muscles (*ophthalmoplegia externa*) by ptosis being absent. (Noyes.)

Other symptoms which are not so constant may also often be noted in these cases.

**CONJUNCTIVAL CHEMOSIS.**—This may be localized or general, and indicates in a measure the location and extent of the morbid process.



*Eyelids.*—In inflammatory action of the orbital cellular tissue there will be redness, edema and swelling of the lids.

*Pain.*—Usually most pronounced on palpation, or on attempting to move the eyes. Frontal headache, which if neuralgic in character will generally show that the frontal sinuses are also implicated. Pressure along the margin of the orbit will show tenderness when the periosteum is diseased. Fluctuation may or may not be present in orbital abscess.

VISUAL DISTURBANCES.—The severity of the disease will determine the amount of the disturbance. In many cases no change will be noted, but as already stated, marked fundus changes may occur.

PERIOSTITIS.—Orbital periostitis may be acute or chronic. The acute form may be circumscribed, or it may be a diffuse suppurative disease.

*Symptoms.*—In the acute circumscribed form, there is pain and tenderness over the lesion which is usually at the orbital margin. Conjunctival injection and chemosis, swelling of the lids and protrusion of the globe. In the diffuse type these symptoms are exaggerated, and fever, headache, delirium and stupor may also be present. It is difficult to differentiate between this type and orbital cellulitis.

In the chronic form the pain is deep-seated, and frequently worse at night, tenderness when pressure is made on the eyeball. The tissues at the margin of the orbit are thickened, the lids and conjunctiva may be swollen, and protrusion of the ball is sometimes present. Syphilitic periostitis, occurring either as a *gummatous* or *sclerosing* form, is found most frequently at the orbital margin. The orbital walls back of Tenon's capsule are less liable to be affected, but if they are, it usually is gummatous. The upper and outer walls are often involved, when trigeminal neuralgia worse at night and in damp weather, is usually found. The mobility of the eyeball is impaired, and it frequently deviates

from the normal meridian, diplopia resulting. Optic neuritis may follow.

*Causes.*—Syphilis, either as a secondary or late manifestation, is often a cause of the chronic type, other factors being rheumatism, scrofula, or injuries.

*Prognosis.*—When circumscribed, favorable. In the diffuse and suppurative types, the probabilities of extension to the other orbital tissues, producing permanent lesions of the orbital muscles or optic nerve, or even exciting a meningitis, must be considered. The chronic form may last for months, and necrosis and caries of the bone, and fistulæ frequently follow. In the syphilitic form the prognosis is best.

*Treatment.*—In syphilitic cases iodide of potassium, chloride of gold and sodium, biniodide of mercury, phytolacca and iris. In rheumatic cases the salicylates, salicylic acid, gelsemium, bryonia, rhus tox, etc. Scrofulous cases, lime in some form, iodide of arsenic. It is very important in these cases to keep the bowels active.

In an acute periostitis, an incision into the diseased area should be made, evacuating the pus.

**CARIES AND NECROSIS.**—Traumatism, especially in scrofulous subjects, may cause caries of the orbital margin. Syphilis or scrofula may also cause it without a traumatism.

*Symptoms.*—In the early stages does not vary from periostitis, but pus developing, the abscess finally reaches the surface, usually through the lid immediately over the diseased area. Rupture and discharge of pus follows, and a fistulous tract, surrounded by granulations, will form. A probe passed through the fistula will detect the softened bone. Deformity of the lid, usually ectropion, often results.

The margin of the orbit is the usual location of caries, and children are most liable to this condition. The orbital roof may become carious, and when it does, the danger to



life on account of the close proximity of the brain must be remembered.

Necrosis is not so often seen, and generally is caused by an osteitis, the result of an acute periostitis, or a fragment of bone resulting from a traumatism, may become necrotic.

*Treatment.*—The fistulous tract should be carefully cleansed several times daily, using an unirritating cleansing solution. A solution of borate of sodium, boric acid or pyoktanin (blue) 1 to 1000 has given good results in several cases. The employment of peroxide of hydrogen is not advisable, as the products of decomposition may be forced into the surrounding cellular tissue.

The advice often given to use well diluted mineral acids for destroying the bone is not ordinarily a safe procedure. Conservative measures are to be recommended in these cases, as too much probing may cause extension of this condition. When the roof of the orbit is involved, surgical measures must be carefully executed. Removal of necrosed bone should be attempted only when it is near the surface, or when completely detached.

Constitutional remedies should be employed as indicated, the treatment not varying materially from that given under periostitis.

ORBITAL CELLULITIS (Phlegmon of the Orbit).—Several varieties of inflammation of the orbital tissues are included under this term. The inflammatory action may be acute, sub-acute, or chronic, and one or both orbits may be affected. The termination of the disease may be by resolution, but as a rule suppuration follows.

In the mild type, the symptoms will be dull pain, slight protrusion of the eyeball, diplopia, and some swelling of the lids. Inflammatory and constitutional symptoms may be lacking.

The acute phlegmonous type is associated with chills, fever, deep-seated pain, much increased by movements of the eyeball. Severe general headache is usually present,

and protrusion, with partial or complete immobility of the eyeballs. The conjunctiva becomes hyperemic and chemotic, and the lids edematous, the appearance simulating a purulent conjunctivitis.

Vision may not be affected for some time after the onset of the disease, but often an optic neuritis or neuro-retinitis appears, with the resulting changes in the nerve and retina. As a result of the morbid condition the pupil may be dilated, the cornea become anesthetic and ulcerate, and in very severe cases suppuration of the eyeball may occur. After a time fluctuation develops, and as a rule pointing appears below the inner portion of the supra-orbital ridge. A sub-acute or chronic abscess does not show as severe or distinctive symptoms as the acute, and may be mistaken for, or even be associated with periostitis, caries, and necrosis, or result from an injury with or without the presence of a foreign body.

*Causes.*—Traumatism, exposure to cold, scarlet fever, typhoid fever, meningitis, or facial erysipelas, when both eyes are usually affected and the disease is extremely severe. Carious teeth and suppurative diseases of the accessory nasal sinuses; a metastasis in puerperal septicemia and in pyemia. In two cases the exciting cause, so far as I could determine, seemed to be influenza. In some cases no cause can be assigned, and it is termed idiopathic. Cellulitis may also result from periostitis, or where there is a general inflammatory condition of the eyeball.

*Prognosis.*—In mild cases favorable. In severe cases the resulting vision, as well as the probable fatal termination of the disease, must be considered. Vision may be considerably impaired or totally destroyed, through nerve or retinal changes, or ulceration of the cornea. When the disease is the result of erysipelas, or both orbits are involved, death usually follows.

Cerebral complications in other forms may occur, through pus or inflammatory action passing backwards and producing a cerebral abscess or meningitis.



When the disease is the result of pyemia, phlebitis of the orbital veins may be a complication, and extend to the cavernous sinus. When the cavernous sinus of the opposite side becomes affected, the corresponding orbit will be involved, and the characteristic symptoms will show. Death generally follows in these cases. When the pus finds an exit anteriorly, the danger to life is much diminished, but visual disturbances may be permanent.

*Treatment.*—The patient should be kept absolutely quiet. Internally during the acute stage, aconite or veratrum. Bryonia is often an indicated remedy. Lime in some form should always be given. If a pyemic condition is present, the administration of chlorate of potassium, sulphite of sodium, or baptisia. Other remedies which will be found indicated in many cases are phytolacca, rhus tox, apis, and apocynum. The bowels should be freely evacuated with a saline cathartic.

Hot compresses, frequently changed so that a poultice action is avoided, may be useful in some cases. As soon as pus is suspected one or more incisions should be made with a narrow knife. The flat of the blade should be parallel with the eyeball, and the puncture deep enough to reach the pus. In two cases following influenza, incisions were made on the second day, and although no pus was found, there was immediate relief from the most marked symptoms, and the day following some pus was evacuated. Free drainage should be secured in these cases, and unirritating cleansing solutions used.

**TENONITIS** (Inflammation of the Oculo-Orbital Fascia).—This seldom occurs as a primary disease, and it is supposed to be a rheumatic manifestation. It has been seen in some cases associated with diphtheria and influenza.

A secondary form is frequently found in severe inflammatory states of the globe, or at times following traumatism.

*Symptoms.*—Pain on motion of the eye, exophthalmos, diminished mobility, and probably diplopia. The lids more

or less edematous. The most characteristic symptom however, is a partial or complete watery chemosis of the conjunctiva. If partial, it is usually situated over one of the recti muscles.

*Treatment.*—Salicylic acid or the salicylates, rhus tox, bryonia, iodide of potassium, cimicifuga, jaborandi.

**THROMBOSIS OF THE CAVERNOUS SINUS.**—This may not only result from phlebitis of the orbital veins, but also, sometimes may be of intra-cranial origin. Caries of the petrous portion of the temporal bone in suppurative disease of the middle ear may be a factor. These cases present a line of symptoms similar to those of orbital cellulitis. The result is usually fatal.

**ORBITAL TUMORS (Tumors of the Orbit).**—For convenience these have been divided into tumors of the orbital tissues; tumors of periosteal or bony origin; tumors commencing in the cavities or tissues surrounding the orbit; and *pulsating exophthalmos*, a condition resulting from vascular lesions in the orbit, or cranium in immediate proximity to the orbit.

Tumors may be primary, metastatic, congenital, acquired, benign or malignant.

*Symptoms.*—These vary according to the size, character and location, but many features in common with orbital diseases are present. When a tumor is situated within the cone formed by the recti muscles, the protrusion of the eyeball is usually forwards, but if external to the cone, the displacement will depend upon the size, location and character of the tumor. As the protrusion continues the lids become distended, and in severe cases it may be impossible to close the lids over the eyeball.

*Prognosis.*—This will depend upon the kind of tumor, its size, location, rapidity of growth, and accessibility to surgical interference.

*Treatment.*—Surgical measures are required in these cases, excepting those tumors originating from vascular dis-



eases. In benign tumors, if the eyeball is not affected it should, if possible, not be removed. Malignant growths will nearly always require both the removal of the eyeball and also the orbital tissues.

**ORBITAL TUMORS.**—In this division cysts are the most frequently found. They may be sebaceous, serous, blood or dermoid, cysticerci or echinococci. Other forms are simple and cavernous angiomas, lipoma, enchondroma, lymphoma, and types of sarcomas may have their origin in any of the fibrous or connective tissues of the orbit. Carcinoma occurs only in connection with the lachrymal gland.

*Diagnosis.*—A differential diagnosis is sometimes extremely difficult, but by a careful study of the case it can usually be made.

*Treatment.*—Fluid cysts require simply an incision, followed by syringing with a mild astringent. Dermoid cysts should be carefully emptied of their contents, and the cyst walls destroyed, using a solution of thuja 1, glycerine 2, aqua 16. Buller uses tincture iodine or nitrate of silver for the same purpose. Some of the solid tumors can be shelled out very easily, but may require dissection.

An encephalocele should not be mistaken for a cyst. Orbital angiomas when circumscribed may be dissected, and electrolysis has been found efficacious in the removal of some of these growths.

**PERIOSTEAL OR ORBITAL WARTS.**—Sarcoma, or fibro-sarcoma, may grow from the periosteum.

Thickening of the periosteum, especially if circumscribed and associated with hypertrophy of the underlying bone may resemble a true tumor. A multiple or diffuse thickening may be found.

**EXOSTOSES.**—These are infrequently found and the growth is slow. They are very hard, having an ivory like surface, while the center as a rule is more spongy. Sometimes they are congenital, and occasionally may follow an injury, while often no cause can be assigned. They may

attain such a size as to produce considerable deformity. Usually their origin is from the periosteum, and are most frequently located at the upper border, but may be found at any portion of the margin. Bony tumors from adjacent cavities are generally more rapid in their growth.

*Treatment.*—Surgical. Incisions of the overlying tissues down to the tumor, then drilling through the base, completing the operation with mallet and chisel. The operation is a serious one, especially when the orbital roof is involved.

TUMORS COMMENCING IN THE CAVITIES OR TISSUES  
SURROUNDING THE ORBIT.

ENCEPHALOCELE, OR MENINGOCELE.—An infrequent form which contains cerebro-spinal fluid and possibly cerebral substance. Congenital, and results from arrested development of the bony walls. The tumor is smooth and fluctuating, and pulsation may at times be seen. It is free from the skin, and has been mistaken for a dermoid tumor. No measures will relieve the condition.

NEVI, LUPUS, EPITHELIOMA.—Any of these morbid conditions may invade the orbit from the skin or eyelids.

Polypi from the nasal cavities; osteoma, or tumors from any of the surrounding cavities, or their distention by fluid, may invade the orbit, giving the appearance of orbital tumors. At times it is very difficult to make a positive diagnosis in these cases.

Andrews states that osteoma of the frontal sinus is found at the upper inner angle of the orbit. Polypi and suppuration of the sinus may also be present.

Osteoma of the ethmoidal sinus occurs at the inner angle, and there is lateral displacement of the eyeball.

Osteoma from the maxillary sinus will show behind the lower lid, and upward displacement of the eyeball results.

Osteoma of the sphenoidal fissure will diminish and destroy the sight, through compression of the optic nerve. Removal of osteomas in the sinuses is a serious undertaking.



**PULSATING EXOPHTHALMOS.**—This term is used for describing several conditions which may originate from different causes.

*Symptoms.*—Usually there is protrusion of the eyeball; pulsation, which occasionally may be seen and felt; and a distinct *bruit* which may be detected by the stethoscope placed on the forehead or over the closed eyelid. The eyelids may be swollen, and there is a passive hyperemia of the veins of the lids and sub-conjunctival tissue. The retinal veins tortuous and distended, and retinal hemorrhages or an optic neuritis may be present with associated visual disturbances. The external manifestations are increased by bending forward.

Subjective symptoms are tinnitus aurium and noises in the head, and are synchronous with the heart's action. Pain in the head, increased by stooping. These symptoms may be diminished by compression of the carotid artery. This condition generally results from an *aneurismal varix* in the cavernous sinus, arterial blood being forced into the orbital veins from the internal carotid. In a few instances an intracranial aneurism of the ophthalmic artery has been found to be a cause. Other lesions have been ascribed as factors. The primary cause is usually a traumatism of the head or face.

*Treatment.*—Spontaneous cures have been reported. Rest in bed and frequent compression of the common carotid has been successful. The administration of iodide of potassium is recommended, but the use of cardiac sedatives will give better results. If the disease progresses, ligation of the common carotid has proven satisfactory in the majority of cases.

**EXOPHTHALMIC GOITRE (Cardiac Exophthalmos, Graves' Disease, Basedow's Disease).**—In this disease the most noticeable symptom is the unusual protrusion of the eyes. This may be due either to protrusion of the globe, or the palpebral fissure may be increased in width, thus exposing



more than the normal amount of sclera. Both of these conditions may be associated. When the disease is fully developed there is cardiac irregularity or palpitation, enlargement of the thyroid and exophthalmos.

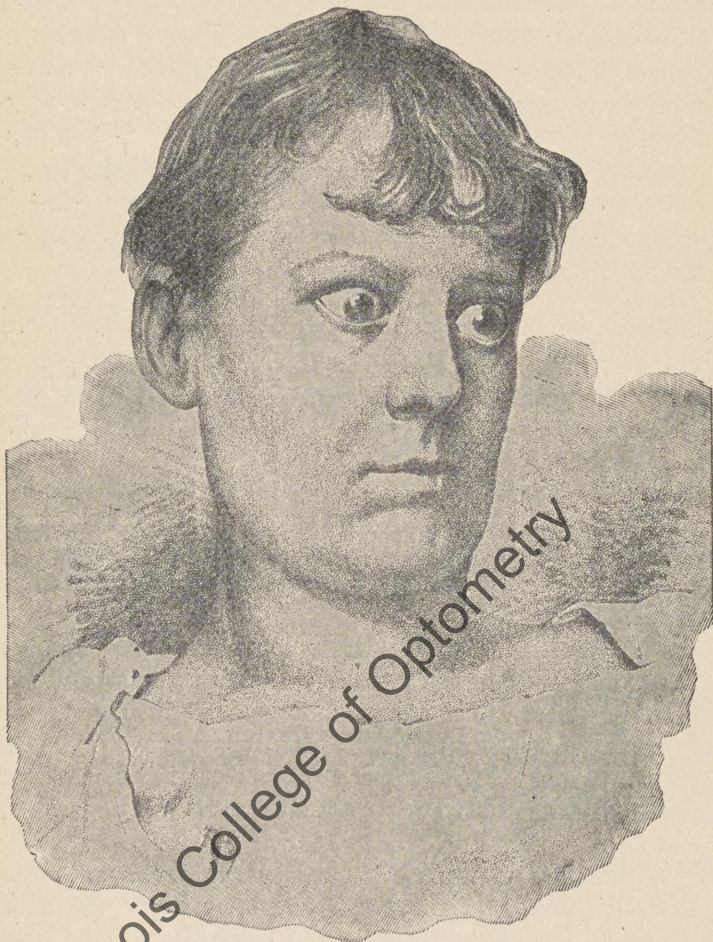


FIG. 92.—Graves' Disease.—*Berry.*



The disease is supposed to be of nervous or psychic origin. Variations are found in these cases, from a slight prominence to such extreme protrusion that the eyelids cannot be closed.

*Stellwag's Sign.*—Either the power of winking is diminished, the lids not closing, or is more pronounced than usual. In some instances the winking may be in rapid succession, followed by complete cessation of movement of the lids for some time.

*VonGraefe's Sign.*—This may be one of the earliest symptoms. There is a lack of consensual downward movement of the upper lid with the eye. The motion may be slight or entirely lacking.

*Dabrymple's Sign.*—Retraction of the upper lid increasing the width of the palpebral fissure.

**CORNEAL CHANGES.**—When the exophthalmos is considerable, the imperfect closure of the lids may cause dryness of the corneal epithelium. Ulceration has occurred in this condition but is infrequent. In a few cases there has been complete opacity, or sloughing of the cornea, blindness resulting.

*Pain.*—At times there may be severe pain in the eyes, with profuse, scalding lachrymation.

Sudden forward dislocation has been reported. This may be repeated many times. Yeo has reported the loss of cilia and eyebrows.

Auscultation may reveal a more or less continuous bruit.

Pupillary reaction to light and convergence is not diminished, but slight dilatation may be present. If an iritis or corneal ulceration has occurred, there may be posterior or anterior synechiæ.

Ophthalmoscopic changes are rarely seen, but in some cases dilatation of the arteries has been found. Atrophy of the optic nerve may result from the traction exerted by the forward dislocation.

The disease is most frequently seen in women, and between

the ages of twenty and forty it is oftenest seen. It may occur earlier or later. One eye only may be affected, but usually it is bilateral. The thyroid is usually enlarged and also the heart, the left ventricle the most frequently, and cardiac murmurs may be heard, but these disappear if recovery occurs, which would indicate that they were functional. Distention and pulsation of the carotid is often found, and the pulse is 100 or over. Mental and physical exertion will increase the rapidity of the heart's action.

The pathology of the disease is not understood.

*Causes.*—The exciting causes may be fright, worry, mental excitement, etc. Disease of the generative organs has also been credited with being an exciting cause. The individuals in which the disease is found are often excitable and irritable, and anemia or chlorosis is nearly always present.

*Prognosis.*—Some cases fully recover, while in others no improvement can be obtained. The more pronounced the protrusion of the eyeball, the more danger to the integrity of the cornea, and successful treatment in these cases is the exception on account of the exposure of the cornea through imperfect closure of the lids.

Tarsorrhaphy has been recommended for narrowing the palpebral fissure. (See operations.)

The treatment of the disease will be found given in the text-books on general medicine and nervous diseases.

#### DISEASES OF THE ADJACENT CAVITIES.

Besides the morbid growths which have been considered, there is:

*DISEASE OF THE FRONTAL SINUS.*—Distention of the sinus by mucus, (mucocoele), or pus, (empyema): The accumulation of secretion in the sinus results from some obstruction of the infundibulum; it may be from catarrhal states of the nasal passage; periostitis, resulting from injuries, or idiopathic. The sinus, sometimes both, becoming filled with secretion, may cause a thinning of the walls,



and the distention presents as a tumor, most frequently at the upper inner angle of the orbit.

The disease may develop during acute infectious diseases, influenza or erysipelas. Frontal headache, increased on lowering the head and stooping, is a common symptom, and pressure at the upper inner angle will increase the pain. Displacement of the eyeball, diplopia, and occasionally through pressure upon the lachrymal sac, epiphora.

*Prognosis.*—The disease is essentially chronic in its course, although the onset may be sudden. It may be found at any time after about six years of age, as prior to this time the sinuses are not developed.

*Treatment.*—When the tissues of the nasal cavities show a thickened condition, and the tissues will pit fairly readily on pressure with a probe, evacuation of the sinus can usually be obtained by using pledgets of cotton saturated with glycerine; these to be pushed well upward, bringing them as near the roof of the nose as possible. The pledget should be allowed to remain about twenty minutes, and then after the lapse of an hour another should be introduced. As a rule two or three applications will be sufficient to empty the sinus of the accumulated secretion.

This treatment should be followed by the introduction of pledgets of cotton covered with an ointment of salicylic, acid grs. xx to ʒj. These pledgets should be placed as far up as possible, and allowed to remain an hour. I have found very few cases in which the sinuses were not freely emptied by this treatment.

Internally during the acute stage, aconite, gelsemium, rhus tox. The administration of lime in the shape of sulphide will have a tendency to reduce the tendency to pus formation. The continuation of the latter treatment will effect a cure in the majority of cases.

Surgical interference will often be required in cases that have been neglected. An incision should be made near the upper inner margin of the orbit, directing the incision upward and forward, as the bony wall of the sinus at this

point is extremely thin, if perforation has not already occurred. The sinus should be carefully cleansed of all morbid material. The connection between the sinus and the nose should be re-established, and drainage from the orbit through the opening into the nose should be maintained.

In some cases the sinus is opened directly from the nose, while in other instances the opening is made a little above the root of the nose and to one side of the median line, and establishing communication from the nose to the sinus, as in the first operation. Where surgical measures are required the utmost care should be observed to keep the surface thoroughly cleansed.

**ETHMOIDITIS.**—A suppurative inflammation of the ethmoidal cells may occur with the formation of abscess of the orbit. When this occurs the tumor will be found at the upper inner angle or inner wall of the orbit. When pulsation is found, or a positive diagnosis has been made, a free incision with evacuation of the contents should be made. The incision should be such as to expose the orbital plate of the ethmoid. After the removal of necrosed and carious bone, an opening should be made into the nose, and a drainage tube passed, so that the cavity can be freely cleansed. The treatment in these cases should be similar to that of disease of the frontal sinus, excepting that as a rule local applications are of little use.

**FISTULA OF THE ORBIT.** This may result from frontal sinus disease or an ethmoiditis.

*Treatment.*—Curettage and drainage. In some cases it may be necessary to re-establish communication with the nose.

**INJURIES OF THE ORBIT.**—Fracture of the walls, penetrating wounds, contusions and the presence of foreign bodies. The result of an injury will depend upon the character of the wound, and the missile which caused it. Phlegmonous inflammation, hemorrhage into the tissues, destruction of vision, either through rupture of the eyeball



or injuries to the optic nerve may result. Exophthalmos, and diplopia may follow even in slight injuries.

Hemorrhage into the orbit may occur during the course of certain diseases, as scorbutus and hemophilia.

*Prognosis.*—This will depend upon the extent and character of the lesion.

*Treatment.*—A careful search for a foreign body should always be made in penetrating wounds of the orbit. If the penetrating substance has severed one of the ocular muscles, and the case is seen soon after the accident, an attempt should be made to suture the ends of the muscle. When hemorrhage within the orbit is excessive, it may be necessary to make an incision, to allow the escape of blood, or to remove the coagulated mass.

**DISLOCATION OR LUXATION OF THE EYEBALL.**—Luxation of the ball from between the lids, which contract behind it, may occur. Laceration of the nerve and destruction of vision usually happen in these cases, although in some instances the sight has been undisturbed.

*Treatment.*—If there has not been much laceration of tissue, the replacement of the eye and the application of a pressure bandage should be made. In some instances the external canthus has been divided to aid in the reduction, the wound afterwards being closed with sutures.

**ENOPHTHALMOS.**—This is a retraction of the eyeball into the orbit. Sometimes it is idiopathic, or it may be traumatic. In exhausting diseases where there is considerable emaciation, retraction may be present, but usually it is more apparent than real. A traumatism in the orbital region may be immediately followed by enophthalmos, but the condition may not occur for days or even months. Paralysis of Muller's orbital muscle from sympathetic lesions may produce it. The orbital cellular tissue may be atrophied; fracture and depression of the orbital bones; cicatricial adhesions or contraction; or a paralysis of the inferior oblique muscle may sometimes be found.

## CHAPTER XVIII.

### MOVEMENTS OF THE EYEBALLS AND THEIR ANOMALIES.

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The muscles controlling the motion of the globe are six in number, the four recti and the superior and inferior oblique. The action of the superior oblique is from the pulley to its insertion in the globe, the posterior portion not influencing the action of the muscle upon the eyeball.

An anomalous position of one or more of the muscles will produce a defective motion of the eye, depending upon the insertion or development of the abnormal muscles. In some instances there has been a complete absence of the muscles, or only a partial development of them. They may be too short or too long. A positive diagnosis of the anomalies can not always be made from the motions of the eye.

The *primary position* of the eyes is considered to be approximately that assumed when, with the head erect, the eyes are directed at an object in front and on the same plane as the eyes, and at a sufficient distance so that the visual lines are practically parallel. The vertical plane, or vertical meridian, is understood to mean a line passing through the center of either pupil perpendicularly to a line passing through the centers of the two pupils.

Secondary positions are assumed when the eyes are moved in any direction from the primary position. When the eyes move directly upward, downward, outward, or inward, the vertical plane will not deviate from the perpendicular. Oblique motion will produce deviations of the vertical plane to the right or left.



The muscles controlling the movements of the eyeball and their movements are :

| MUSCLES.                                       | MOTION.               |
|------------------------------------------------|-----------------------|
| Internal rectus.                               | Inward (adduction).   |
| External rectus.                               | Outward (abduction).  |
| Superior rectus, inferior oblique              | Upward.               |
| Inferior rectus, superior oblique              | Downward.             |
| Internal and superior recti, inferior oblique. | Inward and upward.    |
| Internal and superior recti, superior oblique. | Inward and downward.  |
| External and superior recti, inferior oblique. | Outward and upward.   |
| External and inferior recti, superior oblique. | Outward and downward. |

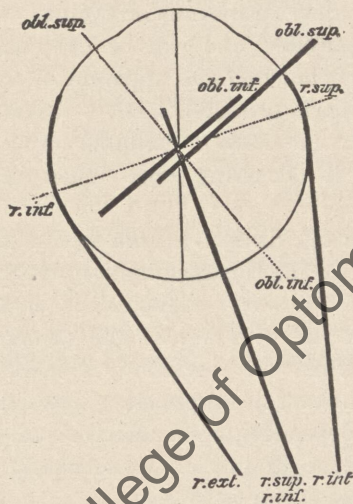


FIG. 93.—Attachments of the Muscles and their Axes of Rotation.

The heavy lines represent the muscles and the dotted lines the axes of rotation. The vertical axis, i. e., of the external and internal recti, being perpendicular to the plane of the paper is not shown.

ASSOCIATED MOVEMENTS OF THE EYES.—Normally the two eyes move in unison, and binocular vision results, the observer being conscious of but one object. When, through deficiency of muscular action, paresis, or paralysis, the co-ordinated movements are interfered with, diplopia or double

vision results. The extent of the motion of the eyes in looking at an object at a distance, determines the field of *binocular fixation*; and the extreme extent of motion, still preserving parallelism of the axes, gives the *field of binocular single vision*, which is normally from forty to fifty degrees from the primary position. Diplopia occurring when the eyes have moved less than thirty degrees from the primary position, indicates a morbid state of the muscles.

Convergence is the ability to co-ordinate the parallel movements of the eyeballs to an object near the eyes, as in reading, and is controlled by the internal recti.

STRABISMUS AND HETEROPHORIA.—When the deviation of the eyes is such that the patient cannot voluntarily overcome it, it is called strabismus or squint. When the deviation is not observable, and can be overcome by voluntary muscular effort, but becomes apparent by special tests, it is called heterophoria or insufficiency. Deviation may be constantly present (*constant*); variable in constancy (*intermittent*); and if occurring only under certain conditions, *periodic*.

When either eye fixes, i. e., one eye at one time, and the other possibly during the examination, it is called *alternating strabismus*. *Orthophoria* denotes a normal state of the muscles when the eyes are in the primary position. In heterophoria when the deviation is inwards, it is called esophoria; outwards, exophoria; upwards, right or left hyperphoria, depending upon which visual line is highest; and downward, right and left hyperphoria, depending also upon which visual line is lowest.

CONVERGENT STRABISMUS.—The fixing eye is directed to the object while the other turns inward towards the nose. The false image is on the side of the deviating eye, simple or homonymous diplopia.

DIVERGENT STRABISMUS.—The fixing eye is directed as in the former case, but the deviating eye turns outward.



The false image is on the side of the fixing eye, crossed or heteronymous diplopia.

UPWARD OR DOWNWARD STRABISMUS.—This condition seldom occurs as a simple vertical deviation, there being more or less lateral displacement as a rule.

VARIETIES OF DIPLOPIA.—Two forms of diplopia result when the associated movements of the ocular muscles are interfered with. When the two images correspond to the eyes that see them, that is the right image is on the right side, and the left on the left side, it is called simple or homonymous. When the image of the left eye is seen on the right side and that of the right eye on the left side, the diplopia is crossed, or heteronymous. When they are on a horizontal line it is called lateral diplopia, but when one image is above the other, vertical diplopia.

The action of the muscles individually should be studied on account of their influence in paralysis. The internal and external impart only the movements given in the table.

In paralysis of the internal rectus, the motion inward is limited and the eye turns outward, *divergent strabismus*. Crossed or *heteronymous* diplopia, double vision results. The false image is parallel and on the same level as the true, and appears on the side of the normal eye. The direction of the face is towards the normal eye. When the affected eye fixes, the sound eye will turn outward, *secondary* deviation.

PARALYSIS OF THE EXTERNAL RECTUS.—Limited outward motion, the eye turning inward, *convergent strabismus*. Homonymous diplopia results. The false image is parallel with the true, and on the same side as the affected eye. In this form the *secondary* deviation is inward.

SUPERIOR RECTUS.—The action of this muscle is upward and inward, inclining the vertical meridian inward.

Paralysis of this muscle limits the motion upward and inward, and the eye deviates downward and towards the affected side, *strabismus deorsumvergens* and a little *diver-*

*gent.* The diplopia is vertical and slightly crossed, the image of the affected eye being above and inclined toward the normal side. *Secondary deviation* is upward and toward the sound side.

**INFERIOR RECTUS.**—The direction of action of this muscle is downward and inward, inclining the vertical meridian outward.

Paralysis limits the motion downward and inward. Deviation of the eye upward and towards the abnormal side, *strabismus sursumvergens* and a little *divergent*. The vertical meridian inclines toward the nose, and the false image is below and on the side of the normal eye, *vertical* and *crossed diplopia*. *Secondary deviation* is downward and to the sound side.

*Inferior Oblique.*—This moves the anterior portion of the eye upward and outward, inclining the vertical meridian toward the temple.

*Paralysis.*—Limitation of motion upward and outward. Cornea turns downward and toward the healthy side. *Strabismus deorsumvergens* and a little *convergent*, and the vertical meridian is inclined towards the nose. The false image is above and on the side of the affected eye, *vertical* and slightly *homonymous diplopia*. The upper end of the image inclines outward. *Secondary deviation*, upward and toward the morbid side. *Strabismus sursumvergens* and *convergent*. The vertical meridian inclines towards the affected side.

*Superior Oblique.*—As the direct action of the muscle is exerted from the pulley only, the posterior portion is not considered in the movement imparted by this muscle. The anterior portion of the eye is directed downward and outward, inclining the vertical meridian towards the nose.

*Paralysis.*—Motion downward and outward is limited. Deviation is upward and towards the normal side, *strabismus sursumvergens* and a little *convergent*. The vertical meridian inclines outwards. The false image is below and on the side of the affected eye, *vertical* and *homonymous*



*diplopia*, and also inclines toward the normal side. *Secondary deviation* is downward and towards the affected side, and the vertical meridian inclines outwards.

As there is special nerve distribution to the external rectus sixth (abducens), and the superior oblique fourth (patheticus), paralysis of either of these muscles may occur without the remainder being implicated. The *common motor oculi* (third) supplies the internal, superior, and inferior recti, and inferior oblique, so all of these muscles are usually more or less affected when paralysis affects any one of the group.

**PARALYSIS OF THE THIRD PAIR.**—The motions of the globe toward the normal side, upward and downward, are limited. As a rule in paralysis of the common motor oculi, there will be other symptoms, as ptosis, mydriasis, and paralysis of the ciliary muscle, as the levator palpebræ superioris, sphincter pupillæ, and ciliary muscle are supplied by this nerve. This is very marked in complete paralysis of the third pair.

*Associated Paralysis* is where the associated muscles of the two eyes are affected, the external rectus of one and the internal of the other, or both of the interni, externi, or the levators or depressors of both eyes.

*Total ophthalmoplegia* is the term used when all the motor muscles of one or both eyes are paralyzed, complete immobility resulting. Ptosis is almost invariably present in these cases.

**EXAMINATION AND DIAGNOSIS OF THE AFFECTED EYE.**—When the paralysis is complete, there is not much difficulty in determining the condition, but if it is the result of a paresis it is not always so easy to make a positive diagnosis.

The patient should be seated about eighteen or twenty feet from a lighted candle, having the head and eyes in the primary position. Covering one eye with a colored lens, usually red, so as to give a distinct tint to the flame, the condition can more readily be determined. When the eyes are

turned in such a direction as to require action of the affected muscle, diplopia results. When the deviation is inconsiderable, the patient by turning the head may be able to fuse the images. The false image will be seen corresponding to the side of the affected muscle, and the false image moves farther away from the true when the candle is moved in the direction of the paralyzed muscle, or the head is moved, increasing its action. The divergence of the images when the candle is moved obliquely above and below the horizontal plane should be carefully watched. All portions of the field of fixation should be studied to determine whether a certain area only is affected. If diplopia occurs only in the upper field, the superior rectus or inferior oblique is affected; if in the lower field, the inferior rectus or the superior oblique. The false image is highest in the first condition and lowest in the latter. Similar tests should also be made at a distance of three feet.

**FALSE PROJECTION OF THE FIELD OF VISION.**—Normally the location of an object is readily determined; even with one eye closed the object is easily touched when on the opposite side of the median line from the closed eye, on account of the ability to rotate the eye readily to that side. When the external rectus is affected however, the hand will pass to the side of the object.

Vertigo is a not infrequent complication in this condition on account of the confusion which results in trying to determine which is the true image.

Czermak has given the following rules and table: In a parietic condition of any muscle, the inclination of the false image will correspond to the inclination of the vertical meridian when the muscle is normal. Positive muscles or rotators are those which normally incline the vertical meridian to the right. Negative muscles, or rotators, give an inclination to the left. Inclination is to the right in paralysis of a positive, and to the left in paralysis of a negative rotator.



| HETERONYMOUS OR CROSSED<br>DIPLOPIA.                                                        | HOMONYMOUS OR SIMPLE<br>DIPLOPIA.                                                           |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Adductor muscles.                                                                           | Abductor muscles.                                                                           |
| Internal, superior, and inferior recti.                                                     | External recti. Superior and inferior oblique.                                              |
| False image highest.                                                                        | False image lowest.                                                                         |
| Elevator muscles.                                                                           | Depressor muscles.                                                                          |
| Superior recti. Inferior oblique.                                                           | Inferior recti. Superior oblique.                                                           |
| Inclination to right of false image.                                                        | Inclination to left of false image.                                                         |
| Positive muscles.                                                                           | Negative muscles.                                                                           |
| Left superior rectus. Left superior oblique. Right inferior rectus. Right superior oblique. | Right superior rectus. Right superior oblique. Left inferior rectus. Left inferior oblique. |

Convergence of the upper part of the vertical meridian in looking downward and toward the unaffected side, in paralysis of the inferior or internal recti. Convergence also results in looking upward and towards the affected side in paralysis of the external rectus, or inferior oblique.

Divergence is found in looking downward and towards the affected eye in paralysis of the external rectus or superior oblique. Divergence also follows in looking upward and towards the normal side in paralysis of the superior or external recti. A tinted lens placed before one eye will aid in the diagnosis.

*The Prism Test.*—This, as the name indicates, is made with prisms. In examining the recti muscles, the base of the prism should correspond with the defective muscles, which would necessarily bring the apex over the normal muscle; *i. e.*, if the right externus was paralyzed, convergent strabismus of the right eye would be present, and the base of the prism should be out, toward the temple. It is important in testing with prisms that the base corresponds with the normal vertical meridian.

The prism which will cause fusion of the images, or binocular single vision, measures the degree of strabismus. All the recti muscles can be tested, remembering to have the base over the weakened muscle.

The oblique muscles may have to be tested by two prisms, with their bases at right angles to each other, or it may be done by rotating a single prism until the required angle is obtained. If two or more muscles are affected, as in oculo-motor paralysis, the condition is complicated. In these cases the images should be brought into line either horizontally or vertically, and then use a second prism to obtain fusion of the images.

*Causes.*—Paralysis of the ocular muscles may result from central or peripheral lesions. Among the exciting causes, syphilis seems to cause paralysis most frequently. Any syphilitic changes affecting the intra-cranial portions of the nerves may cause paralysis. The oculo-motor nerve is oftenest implicated. Paralysis is seldom seen before the sixth month after the initial lesion.

Rheumatism seems to be a factor in many cases, and as a rule the external rectus is affected. It occurs most frequently after exposure to cold, and seldom if at all during an attack of acute articular rheumatism. The lesion is supposed to be peripheral only. Associated with the paralysis there is usually pain on motion of the eyeball, and frontal pain is often present.

Diphtheria may also be a cause. The external muscle is most frequently affected, but any of them may be implicated, and when the third pair is affected the ciliary muscle is usually paralyzed.

Diabetes, influenza, whooping cough, or herpes zoster may be causes.

Toxic agents, as tobacco, ptomaines, alcohol, chloral, lead poisoning, carbolic acid, and gelsemium. In these cases the paralysis is usually transient.

*Brain Diseases.*—Meningitis, especially tubercular, tumors or aneurisms which press upon the cranial nerves. Multiple sclerosis may also be a cause, but when this condition exists, or it is the result of lesions of the brain other, symptoms will present.



*Diseases of the Spinal Cord.*—The characteristic pupillary changes will usually be present. The paralysis in these cases may be partial and temporary, or complete.

*Injuries.*—Laceration of the muscles or nerve trunk, fracture of the orbital walls or base of the skull. Paralysis originating in the orbital cellular tissues and periostitis.

CONGENITAL PARALYSIS.—This occurs not infrequently, and ptosis is also often present.

It is not always easy to differentiate between a central and peripheral paralysis. A careful examination must be made in order to eliminate errors of diagnosis. Graefe claims that fusion of the images by means of prisms is almost impossible when the lesion is central.

*The Muscles Most Frequently Affected.*—The external rectus is the oftenest paralyzed. Paralysis of the oculo-motor is next in frequency, although Duane gives the superior rectus as second. The majority, however, give as following the externus, the superior oblique, inferior, superior and internal recti and inferior oblique.

*Prognosis.*—This depends entirely upon the cause. A peripheral paralysis, the result of syphilis or rheumatism, is usually amenable to treatment. In many cases the paralysis is incurable, the exciting lesion often being fatal. The necessity of determining the character and location of the lesion is important in these cases.

*Treatment.*—In syphilitic cases the iodide of potassium, pushed until the full physiological effect of the drug is obtained, will often give good results. In rheumatic cases the salicylates and at times iodide of potassium, but the latter not in large doses. *Cinchifuga*, *bryonia*, *rhux tox.* or *rhamnus Californica* may be given. *Nux vomica* and dilute phosphoric acid in diphtheritic cases will often be found beneficial. The indications for drugs must be carefully watched, and as a rule the remedies employed should be given in doses sufficiently large to produce the physiological effect.

In some cases it will be necessary to cover the affected eye

with a shade, or ground glass, which may be mounted in a spectacle frame, having corrected any refractive error which may be present in the other eye. When the degree of strabismus is not excessive, so that prisms which will fuse the double images can be worn, this method will be preferable, but the deviation is usually so great that this method is not practicable. The base of the prisms being placed in the proper direction to fuse the images.

Mechanical motion has been advocated. After a thorough cocaineization of the eye, the conjunctiva is grasped near the insertion of the affected muscle with a forceps, and the eyeball is drawn forcibly as far as possible beyond the usual limit of contraction, and then back again. This exercise should be made daily and for about a minute at a time. Various forms of electricity have been employed, but have not been successful, excepting in a few cases.

When all measures for relief have been tried without success, either a tenotomy or advancement of the paralyzed muscle may be employed. In the majority of cases it is necessary to advance the paralyzed muscle and tenotomize its antagonist. The external and internal muscles are the ones in which the best results are obtained. As already directed under injuries, if a muscle is ruptured and the case is seen soon after the accident, if the ends can be brought together and sutured, it will be the proper treatment.

OPHTHALMOPLÉGIA.—This term is used to designate paralysis of the ocular muscles, and it may be divided into an acute or chronic type.

NUCLEAR OCULAR PARALYSIS.—This term is used to designate paralysis of the external and internal ocular muscles, when they are affected by a lesion, either degenerative, inflammatory, or hemorrhagic, affecting the third, fourth and sixth nerves. Ophthalmoplegia from nuclear disease is nearly always chronic.

ACUTE OPTHALMOPLÉGIA.—Here there is a rapid paralysis of all the ocular muscles. This form may result from



cerebral hemorrhage, or as the result of toxic agents, and may also result from injuries.

In the chronic form, the diminution of action of the muscles comes on slowly and may extend until all the muscles are affected. One eye only may be affected. Diplopia is often an early symptom, but will usually disappear. Ptosis may or may not be present. The disease may last for years.

When the intra-ocular muscles are not affected, it is almost positive proof that the origin is nuclear. A chronic ophthalmoplegia may be congenital, and it has been supposed to be a hereditary affection. Constitutional syphilis, and injuries may also produce it. Progressive paralysis of the insane, and posterior spinal sclerosis, as well as other lesions of the nervous system, may be factors. Men are more often affected than women, and in children it is more serious than in adults.

*Treatment.*—In many cases no treatment will be of any benefit. In syphilitic individuals, the iodide of potassium in large doses; jaborandi or phytolacca in moderate doses may give fairly good results.

ASSOCIATED OCULAR PARALYSES.—Limitation of motion of both eyes, either to the right or left may be found in apoplexy or other severe brain lesions. The power of convergence may be destroyed, and the lateral motion affected, or the vertical motions may be lost.

*Conjugate deviation of the head and eyes* may be found in apoplexy, the head being turned from the paralyzed side as well as the eyes. This is however, not an invariable rule. Prevost states if the lesion is in one cerebral hemisphere, the head is drawn towards the lesion and away from the paralyzed side, but a lesion of the mesencephalon or mid-brain, will cause the head to be drawn away from the lesion and towards the paralyzed side. In convulsions of one side, if the eyes turn towards the affected side, it shows an irritative lesion in the hemisphere, but when the reverse holds true, the irritative lesion is in the mid-brain.

**CYCLOPLEGIA.**—This term is used to designate paralysis of the ciliary muscle. Pupillary dilatation may or may not be present. The principal symptom is loss of the accommodative power, which may be partial or complete, the patient possessing distant vision according to the refractive state of the eye, but is unable to use the eyes for close work. The nucleus of the oculo-motor nerve, or the nerve trunk may be affected. In diphtheria both eyes are often affected. When but one eye, the ciliary ganglion may be diseased. Spinal diseases may also produce this condition. After the age of fifty it is difficult to determine cycloplegia, as the accommodative power is so much diminished.

**COMITANT (CONCOMITANT) AND NON-COMITANT STRABISMUS.**—In comitant strabismus the deviating eye always maintains the same angle of deviation, but follows the normal eye in its movements. A marked example is in nystagmus and associated paralyses. Comitant deviation may be permanent or periodic. When permanent it is usually of one eye, or alternating. An intermittent form is occasionally found. According to DeSchweintiz the average age for strabismus is 3.4 years. After the age of five it is often alternating, and frequently both eyes have good vision.

In the non-comitant type, the angle of deviation varies with the motion of the two eyes. The two are differentiated:

**COMITANT.**

Both eyes are equally affected.

If uncomplicated, one of the centers controlling both eyes is the seat of the lesion.

The affected eye follows the motion of the sound eye, but limitation will be found.

**NON-COMITANT.**

One eye more affected than the other.

An anomalous condition of the muscles, or of the nerves or nerve-centers controlling the movements of one eye.

The affected eye varies in its angle, and may be slower or more rapid in its movement than normal. The extent of the rotation may be lessened or increased.



Diplopia if present may be disregarded. Prisms may not cause the two images to be seen.

Diplopia often present and persistent.

**CAUSES OF COMITANT STRABISMUS.**—Refractive or accommodative errors. Anomalous conditions of the opposing muscles. Size and shape of the globe and orbit, or an amblyopia of one eye.

For convenience the following table will facilitate the diagnosis between a comitant strabismus and paralysis of one of the ocular muscles.

**COMITANT STRABISMUS.**

The motion of the morbid eye follows the normal in all directions.

The angle of deviation always the same. (Mauthner.)

Secondary and primary deviation equal.

No change in position of the head.

Diplopia infrequent.

False projection of field absent.

Amblyopia of the deviating eye usually present in the fixed type.

Ametropia often considerable. Convergent with hyperopia. Divergent with myopia being the rule.

**PARALYSIS OF AN OCULAR MUSCLE.**

Limitation of motion of the morbid eye in the direction of the paralyzed muscle.

The angle of deviation increased when towards the muscle, but diminished when in the opposite direction. (Mauthner.)

Secondary deviation increased

Head usually turned toward side, which diminishes the diplopia.

Diplopia usually present.

False projection of field present.

The deviating eye may have the best vision.

Ametropia not a constant factor.

**MEASUREMENT OF DEVIATION.**—An approximate measurement may be made by using a rule divided into millimeters, or by a specially devised strabisometer which is curved to conform to the shape of the eyeball and tissues of the lower lid. The one eye fixing, the deviation may be

estimated by noting on the rule the deviation. One millimeter approximating five degrees of strabismus.

When diplopia is present, various methods have been employed, among which is the prism method, using such a degree prism as will fuse the double images. Landolt recommends the use of the perimeter in these cases.

*Treatment.*—Convergent comitant strabismus. In these cases hyperopia, often combined with astigmatism, is the rule. The refractive error should be carefully corrected under the influence of atropine mydriasis. In the majority of these cases the mydriatic must be used several days, or at least until objects maintain a clear outline. If they fade and then become distinct, it shows there is still action of the ciliary muscle and the use of the drug must be continued until this change does not take place.

The ophthalmoscopic examination will also detect this condition by the vessels becoming indistinct while under observation. The accommodative action of the observer's eye must of course be eliminated.

Retinoscopy is an invaluable aid in young children, or when the deviating eye is amblyopic. Full correction should be given in these cases. In young persons or where the deviation has not become fixed, glasses will often effect a cure. An idea of the amount of relief which may be obtained can often be estimated by the action of the eyes while under the influence of the mydriatic. If there is a disposition to assume the normal position, glasses will generally be all that is necessary.

In very young children the employment of a weak mydriatic may be of benefit. Under the age of three and one half years it is seldom safe to put glasses on a child, but I do not hesitate to do so after this age, and find as a rule the little ones will call for their glasses as soon as they awake.

The deviating eye should be exercised every day by cover-



ing the sound eye for five or ten minutes at a time. This should be repeated several times daily.

OPERATIVE MEASURES.—After the age of six an operation may be undertaken, provided carefully adjusted glasses have been worn for not less than three months. Correction should always be made first, and if there is a suspicion of the deviation being due to some systemic lesion, this should be overcome in anticipation of benefit following.

A careful examination of the eyes should be made prior to the operation, to determine the visual acuity of each eye and the amount of deviation.

Tenotomy of one internus will correct about 15 degrees of strabismus. Care must be exercised not to over correct, or a divergent strabismus will result. See operations.

DIVERGENT COMITANT STRABISMUS.—In this type, myopia is the rule and it is often associated with astigmatism. Correcting glasses should be prescribed, and the work should be done under a mydriatic, as in the convergent form, full correction being given. The glasses should be worn for both distance and near vision.

Operative measures are more often required in this type than in the convergent. Tenotomy of one or both externi, or an advancement of the internal rectus as well, may be required. When it is impossible to improve the vision of the deviating eye, the operation may still be performed for the cosmetic effect. In divergent cases the resulting visual acuity is not so good, and binocular vision is less seldom obtained than in the convergent type.

SPASTIC STRABISMUS.—This is seldom seen, but has been reported in some hysterical patients, and as following meningitis. It is a very difficult condition to diagnose.

IMBALANCE OR INSUFFICIENCY OF THE OCULAR MUSCLES.—In cases where there is a tendency to deviation from parallelism, but it can be overcome by increased muscular effort, the term heterophoria is employed. Heterophoria is

divided by Stevens into : (1) *Esophoria*, a tendency of the visual lines inward ; (2) *Exophoria*, an outward tendency of the visual lines ; (3) *Hyperphoria* (right or left), a tendency of the visual line of one eye to deviate above the other, making right or left hyperophoria, according to the eye affected.

These terms indicate a tendency to displacement only. There may be a combination of these when the term *hyper-esophoria* (right or left), one line having a tendency above, and inward, and *hyperexophoria* (right or left), the tendency of one line being above and outward.

In these cases diplopia is not the rule, but excessive muscular action will produce a line of symptoms very annoying to the patient. When insufficiency is suspected the eyes should be tested by producing diplopia, which will aid in determining the condition. As it is important that the accommodative power be eliminated as much as possible, the tests should be conducted at a distance of twenty feet.

Placing the patient at this distance from a lighted candle, a prism of six or eight degrees, base down, is held before the right eye. Two images will be seen, and the image of the right eye will be above, that of the left eye below. If the image of the right eye is at the right of the lower one an esophoria, but if it is at the left, an exophoria is present. To bring the two images into a vertical line, a weak prism, base out in the first case, base in in the latter, should be placed either over the prism in use or the uncovered eye, changing the weaker prism until the lights are directly in line. This prism is the measure of the manifest esophoria or exophoria.

If a strong enough prism is placed base in, diplopia will also result and the images will be on the side of the corresponding eyes, homonymous diplopia. The images should be on the same horizontal plane, but if the right should be below, a tendency of the right visual line to rise above is present, right hyperphoria. If the right image is above, the reverse



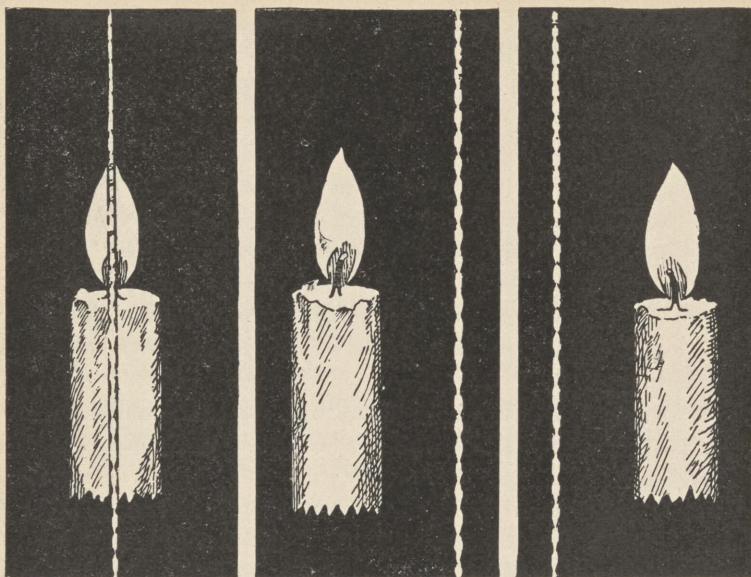
holds true, and left hyperphoria is present. Placing such a prism base up or down as will bring the two images on a horizontal line will be the measure of right or left hyperphoria.

Holding the prism before the eyes with the hand, or placing it in the trial frame, is the simplest method of testing the muscles, but it only approximates the deficiency, as it is not easy for the patient to keep the head steadily in the primary position, or to correctly hold the prism before the eye. The most serious objection is the unconscious effort of the eye to neutralize the action of the prism when placed close to the eye.

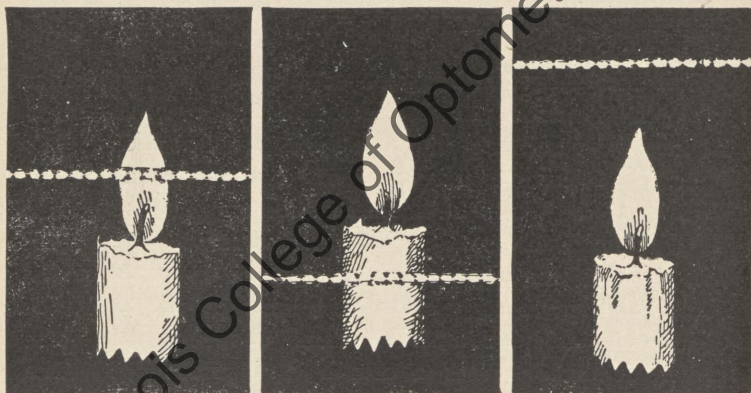
Various devices for overcoming this objection have been devised, the principal ones being Wilson's phorometer and Stevens' phorometer.

The Maddox rod is another method which is used. It consists of a disk which will fit the trial frame, and has a glass rod at the center which has the effect of elongating the flame into a line of light. This line is always at a right angle to the axis of the rod. The effect of this rod can be readily understood by referring to the figures. In order to produce orthophoria, correcting prisms from the trial case can be used.

STEVENS' STENOPÆIC LENS.—The object of this is similar to the Maddox rod, that is, contrasting images. A +13.00 D. lens is covered excepting the optical center which is left clear. In looking at a flame twenty feet distant, a disk of light is seen. When the balance of the muscles is perfect, the flame with the uncovered eye will appear in the center of this disk. In heterophoria it will be away from the center, and may even be outside the limit of the disk. If there is also a deviation of the flame above or below the center, it demonstrates a combined insufficiency. The deviation is corrected in the same way as when prisms alone are used.



Maddox Rod Test for Horizontal Deviation. The rod before the right eye. FIG. 94, Orthophoria. The line passes through the flame. FIG. 95, Esophoria. The line to the right. FIG. 96, Exophoria. The line to the left.



Maddox Rod Test for Vertical Deviation. FIG. 97, Orthophoria. The line passes through the flame. 98, Right Hyperphoria. The line below the flame. 99, Left Hyperphoria. The line above the flame. In these tests the rod is before the right eye.



The action of the muscles in rotating the eye when diplopia has been induced by prisms, is:

If base in, *abduction*; base out, *adduction*; base down, *sursumduction*. A prism base down before one eye or base up before the other has an equivalent action. Fusion of images with base down before the right eye or base up before the left eye is right sursumduction. Reversing the position of the prisms will give left sursumduction.

At twenty feet the standard of strength for the muscles, that is the strength of prism which can be overcome, is stated by Stevens to be abduction 8 degrees, adduction 50 degrees, sursumduction 2 degrees. Variations from these figures are frequent.

A very generally accepted rule is, that the adductive power should be at least five times the abductive, and that it is infrequent for discomfort to follow the use of the eyes if this ratio is present.

When the oblique muscles are at fault it is readily detected by placing a Savage modification of the Maddox double prism before one eye, the other being covered, and direct the patient to look at a horizontal line on a card 18 in. distant. Adjustment of the prism should be such that two distinct parallel lines will be seen, then uncover the other eye, and three lines will be seen. If the muscles are normal, the three lines will be parallel, but an insufficiency of the obliques will cause a deviation of the middle line from parallelism.

If the prism is before the right eye, and the center line is near the bottom line, left hyperphoria, or if it extends to the right or left of the two lines, an exophoria or esophoria exists.

When there is convergence of the right ends of the middle and lower lines, the superior oblique is at fault.

If the convergence is at the left end, the inferior oblique is the weak muscle.

The methods for developing the ocular muscles as given

by Savage have given the best results in my hands. In exophoria the prisms are placed bases out, as the interni muscles are at fault. It is best to commence with the weaker combination, gradually increasing as the muscles are developed.

A lighted candle at a distance of twenty feet and on a line with the eyes should be used. With the prisms in position, the image of each eye is displaced outward, calling into action the interni muscles. After five seconds the frame should be raised, allowing relaxation of the acting muscles. The time allowed for this interval should be the same as for the use of the prisms. The alternate lowering and raising of the prisms should be continued at each sitting, not exceeding ten minutes, but always stopping short of fatigue. These sittings may be repeated several times a day. In many cases the normal condition of the muscles can be obtained by this method, but it will take considerable time.

In esophoria, the external muscles are the ones to be exercised, and the esophoric set contains prisms as low as  $\frac{1}{2}$  degree. The weakest prisms should be used first as in the previous exercise, the method of employment being the same.

In hyperphoria, prism exercise may also give relief. In left hyperphoria the muscle on the left side to be developed is the inferior rectus, and on the right side the superior rectus. The weakest prisms should be used at first, and it is seldom that a stronger prism than 1 degree is needed. The base of the left prism must be up, and of the right one down. In right hyperphoria this arrangement would be reversed.

The method of exercise is the same as already given.

*The Oblique Muscles.*—These may also be strengthened by proper exercise, and a +1.5 D. cylinder will usually give the best results. In this form of trouble it is necessary that the lenses should be properly adjusted to the individual case, in order that the center of the pupil will be opposite



the optical center of the lens. If the weak muscles are the superior obliques, the axes of the cylinders must be placed in the lower temporal quadrant, commencing with 15 degrees from the vertical line and used for five minutes. The method of using them being the same as for the other muscles. The axes may then be changed to 30 degrees and worn two or three minutes, when the axes are again changed to 45 degrees from the vertical, using them intermittently for one or two minutes.

It is important in any of these exercises that the alternate raising and lowering of the prisms be at comparatively regular intervals, as it is the rhythmic exercise of the muscles that gives them their increased strength.

In some cases it may be necessary to perform a partial tenotomy of the weaker muscle or an advancement of its antagonist, but this should not be attempted until after a thorough trial has been given the exercise method. Operative interference is required when the degree of exophoria, esophoria or hyperphoria is so great that it is impracticable to bring the muscles to a normal condition. It is a question whether operative interference on the oblique muscle is ever justifiable, although the operation is advocated by quite a number.

**SYMPTOMS OF MUSCULAR INSUFFICIENCY.**—Muscular asthenopia is the term usually applied, and the symptoms may be ocular or general.

*Ocular Symptoms.*—There may be pain over the insertion of the weak muscle, which may be distinctly marked on sudden movement of the eye in its direction. The vision may be indistinct, and the ability to use the eyes for close work much reduced. The eyes may tire in looking steadily at one object even at a distance, and the fatigue will be increased if the object is moving. Photophobia and occasionally blepharospasm. Contortion of the facial or frontal muscles is sometimes seen.

*General Symptoms.*—The most pronounced is headache,

very generally in the occipital region, and often the patient will awaken in the morning with headache, when on retiring no symptoms were present. The headache may follow the use of the eyes or appear later. Pain in the back, often seeming to pass from the occiput to the shoulder, is not uncommon, and precordial pain is often complained of. Vertigo, drowsiness or insomnia. In fact, most any reflex complication may be found in these cases.

Many nervous disorders, as well as nearly all the ills that befall the human race, have been attributed to this condition.

**NYSTAGMUS.**—This term is used to designate a rapid involuntary movement of the eyeballs. The motion may be lateral, vertical, rotary or mixed, when it comprises two forms of motion. Almost always both eyes are affected. It may be congenital or acquired.

Congenital nystagmus is often found in cases having other congenital defects of the eyes. In albinos it is very frequent. Corneal opacities, or defects in the refractive media of the eye may cause it.

Acquired nystagmus is often seen in miners, *miners' nystagmus*, or where the eyes are used in a dim light. It may also occur in nervous diseases, as disseminated sclerosis, Friedreich's ataxia. Cerebral diseases, and tumors of the cerebellum are also often causes. Chronic fatigue of the muscles, and oscillation of the globe, the result of muscular atony, as well as central disturbances have been ascribed as causes.

**Treatment.**—In many cases no method of treatment will give relief. If there are refractive conditions present, they should be carefully corrected. In some cases the muscles have been tenotomized, or when indicated, an iridectomy has been made. If nystagmus is the result of occupation, a change in the kind of work may effect a cure. In diseases of the brain or cord little or nothing can be done.



**MONOCULAR DIPLOPIA.**—This is a condition which is sometimes found and which may be due to different causes. Refractive errors, especially astigmatism, opacity of the cornea or lens, irregular action of the ciliary muscle, or it may result from an iridodialysis. Hysteria, disease of the brain or meninges with paralysis of the abducens (Gunn and Anderson), and sometimes it is a simulated condition, especially following an injury.

## CHAPTER XIX.

### OPTICAL PRINCIPLES.

**REFRACTION.**—This term is used to designate the change which takes place in a ray of light when passing obliquely from a rarer to a denser medium. A ray of light passing perpendicularly does not change its course, passing directly through the transparent medium.

A ray of light in passing obliquely through glass with parallel sides, will be deviated towards the perpendicular at the point of entrance, but on emerging from the opposite side will be again deviated from the perpendicular, assuming a course parallel to that of entrance.

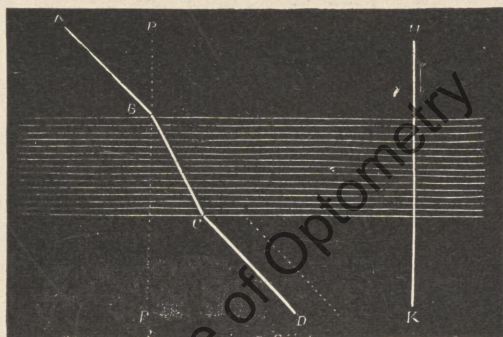


FIG. 100.—Refraction of rays of light through glass whose plane surfaces are parallel.  $AB$ , incident ray;  $BC$ , the ray refracted by the first surface towards the perpendicular,  $PP'$ ;  $CD$ , the ray refracted by the second surface, parallel to the original direction,  $AB$ ;  $HK$ , a perpendicular ray, no refraction.

Air is taken as the index of refraction, indicated as 1., the absolute index being a vacuum, but the resistance offered to the passage of a ray of light through air is but slightly



greater than through a vacuum. A ray of light, *incident ray*, passing obliquely from a rarer to a denser medium, will form with the perpendicular an angle which is called the *angle of incidence*. The angle formed after the deflection of the ray, *refracted ray*, is termed the *angle of refraction*.

If the sides of the denser medium are inclined towards each other, forming a prism, a ray of light entering this prism will be deflected towards the base, and on emerging from the opposite side the ray will be still further deflected, the angle being the same on the two sides. A prism as understood in optics is composed of a transparent substance, usually glass, the inclination of the two surfaces being called the refracting angle of the prism, and is expressed in degrees. The apex of the prism is that part where the two surfaces meet, the base being the line opposite the apex.

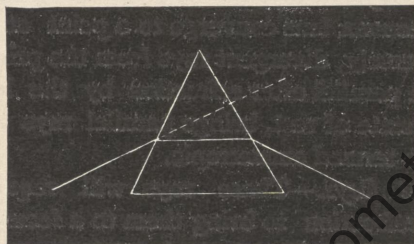


FIG. 101.—Refraction through a Prism. Deviation at each surface towards the base.

In speaking of the position of a prism the direction of the base is always indicated, being up, down, in or out, according to its position. A ray of light striking the surface of the prism is deviated towards the perpendicular. As it emerges it is still further deviated towards the base and from the perpendicular. The angle which the incident and emergent rays form with each other is called the angle of deviation. In a case of muscular insufficiency which is not too great, this refractive property of the prism is utilized at times to fuse the double images.

*The Angle of Deviation for Prisms.*—This is the angle

formed by the incident and refractive rays. The angle being nearly one-half of the refractive angle of the prism from a 1 degree to 10 degrees. Above the latter strength the deviation rapidly increases.

*The Limit of the Angle of Refraction.*—The greatest angle possible is that which the ray forms with the perpendicular, 90 degrees. Different methods of numbering prisms are in use. The centrad or Dennett's and the prism diopetre method of Prentice.

*Rays of Light.*—Light passes from a luminous point in all directions in straight lines, which are called rays. These rays are divergent, but for practical purposes, rays entering the eye from a distance of about twenty feet, are considered parallel, as the rays of light from the sun and stars are also considered parallel.

*Parallel Rays.*—Rays which are parallel, on passing through a convex lens converge to a point at its principal focus; conversely, divergent rays from the principal focus of the lens are parallel after refraction by the lens. An eye, which in a state of rest, brings parallel rays to a focus on the retina is termed emmetropic.

*Divergent Rays.*—These rays will require a greater amount of refraction to bring them to a focus at the same distance behind the lens than when the rays are parallel, hence divergent rays are brought to a focus at a point further back than the principal focus, and the nearer the point of divergence to the lens the further removed the convergent point.

*Convergent Rays.*—Rays of light are never convergent unless they have passed through a convex lens, or have been refracted from a concave mirror.

*Significance of the Different Rays.*—The refractive state of the eye is determined by the direction which the rays must have to focus on the retina.

EMMETROPIA.—Parallel rays will meet on the retina when the accommodation is relaxed. Emergent rays are parallel.



**MYOPIA.**—In order to have the rays converge on the retina they must be divergent from a point near the eye. Emergent rays are convergent.

**HYPEROPIA.**—In order to have the rays focus on the retina the rays must converge. Emergent rays are divergent.

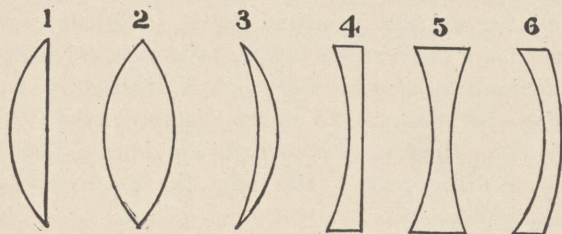


FIG. 102.—1. Plano-convex. 2. Double or bi-convex. 3. Meniscus, convexo-concave or periscopic convex. 4. Plano-concave. 5. Double or bi-concave. 6. Meniscus, concavo-convex or periscopic concave.

**LENSES.**—The usual substance used for lenses is glass, and in speaking of lenses this is understood. There are different forms of lenses, a  $+$ , or convex lens (Fig. 102, No's 1, 2, 3), is one which converges rays of light, and a  $-$ , or concave lens (No's 4, 5, 6), is one which produces divergence of the rays of light. A convex lens may be regarded as a double prism, the bases being together, and a concave

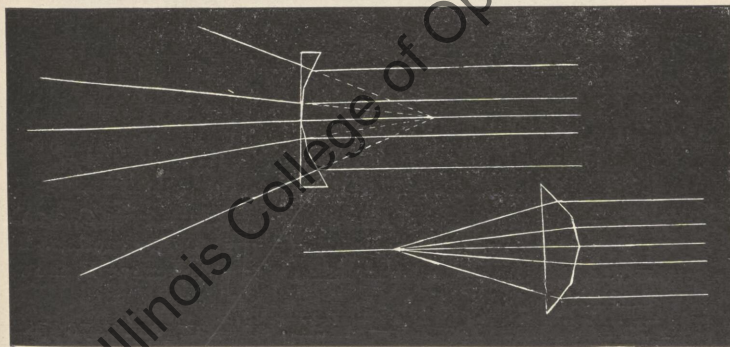


FIG. 103.—Prism Action of Lenses.

as a double prism with the bases away from the center. The prism action of these lenses is well illustrated in the diagram.

*Foci of a convex Lens.*—The *principal focus* is the point where the parallel rays meet after refraction. Rays passing through a lens from a nearer point than infinity, are focused at a point beyond the principal focus, and the points of divergence and convergence are called *conjugate foci*. Conjugate foci are equal when the point of divergence and the point of convergence are an equal distance from the lens, which is twice the focal distance of the lens. The nearer the point of divergence to the lens the more remote the point of convergence.

Divergent rays from a point an equal or greater distance than the principal focus, forms a conjugate focus which is *positive*, but when the distance is less than the principal focus it is termed *negative*.

*Virtual Focus of a Convex Lens.*—Rays diverging from a point nearer than the principal focus of a lens will continue to diverge after refraction. These divergent rays cannot produce a real focus, but if extended backwards would meet at a point on the same side of the lens from which they diverged; this point is termed the *negative*, or *virtual focus*.

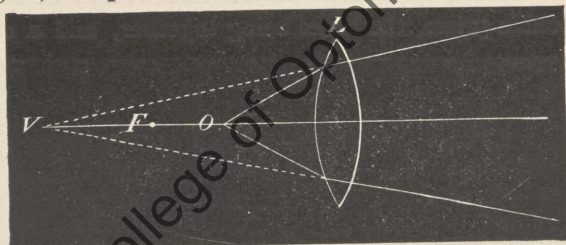


FIG. 104.—Virtual Focus of a Convex Lens. Rays from *O*, a point within the principal focus, still diverge after refraction. The refracted lines extended backwards would meet at *V*, the virtual focus of *O*.

*Foci of Concave Lenses.*—Parallel or divergent rays passing through a concave lens form only *virtual*, or *negative*



foci, which are points from which the rays seem to diverge after passing through the lens.

*Principal Focus of a Concave Lens.*—Parallel rays are rendered divergent after passing through a concave lens, and tracing them backwards, they will appear to have diverged from a point near the lens, which is the *principal focus*. The *conjugate foci* of concave lenses are virtual and are found in the same manner.

*The Optical Center of a Lens.*—This is understood to be a point in a lens through which a ray of light in passing, is equally refracted at both surfaces, both the incident and refracted ray being parallel. All rays passing through the optical center without passing through the center of curvature are not deviated, and the rays are called *secondary axes*.

The size of an image formed by a convex lens is proportionate to the size of the object, as the distance of the image from the optical center is to the distance of the object from this center. If the object is at a greater distance from the lens than its principal focus the image is *real, inverted*.

If the object is nearer the lens than the principal focus, the image is *virtual, erect*.

The virtual image of a convex lens appears to be at the point from which the refracted rays seem to have diverged, and is enlarged.

An image formed by a concave lens is *virtual*, and smaller than the object.

*Focal Distance of a Lens.*—The distance from the optical center to the focal point is the *focal distance*. This depends upon the radii of curvature, as well as the refractive index.

*Numbering of Lenses.*—The refractive power of a lens is the inverse of the focal distance. The refractive power of a lens whose focal distance is one meter is 1, and a lens whose focal distance is two meters, has but one-half the refractive power of the first. If the focus is at one-half meter, the refractive power of the lens is twice that of the first.

The system most generally employed of numbering lenses

| NO. OF LENS IN D. | FOCAL DISTANCE IN<br>ENGLISH INCHES. | NEAREST CORRE-<br>SPONDING LENS IN<br>OLD SYSTEM. |
|-------------------|--------------------------------------|---------------------------------------------------|
| 0.12              | 314.96                               |                                                   |
| 0.25              | 157.48                               | 144                                               |
| 0.37              | 104.99                               |                                                   |
| 0.50              | 78.74                                | 72                                                |
| 0.62              | 62.99                                | 60                                                |
| 0.75              | 52.5                                 | 48                                                |
| 0.87              | 44.99                                | 42                                                |
| 1.00              | 39.37                                | 36                                                |
| 1.12              | 34.99                                |                                                   |
| 1.25              | 31.5                                 | 30                                                |
| 1.50              | 26.22                                | 24                                                |
| 1.75              | 22.48                                |                                                   |
| 2.00              | 19.69                                | 20                                                |
| 2.25              | 17.48                                | 18                                                |
| 2.50              | 15.75                                | 16                                                |
| 2.75              | 14.31                                | 15 or 14                                          |
| 3.00              | 13.12                                | 13                                                |
| 3.25              | 12.11                                | 12                                                |
| 3.50              | 11.25                                | 11                                                |
| 3.75              | 10.49                                | 10                                                |
| 4.00              | 9.84                                 | 9                                                 |
| 4.25              | 9.26                                 |                                                   |
| 4.50              | 8.74                                 | 8                                                 |
| 4.75              | 8.29                                 |                                                   |
| 5.00              | 7.87                                 |                                                   |
| 5.50              | 7.16                                 | 7                                                 |
| 6.00              | 6.54                                 |                                                   |
| 6.50              | 6.06                                 | 6                                                 |
| 7.00              | 5.63                                 | 5                                                 |
| 7.50              | 5.25                                 |                                                   |
| 8.00              | 4.92                                 |                                                   |
| 9.00              | 4.37                                 | 4.5                                               |
| 10.00             | 3.94                                 | 4                                                 |
| 11.00             | 3.58                                 | 3.5                                               |
| 12.00             | 3.27                                 | 3.25                                              |
| 13.00             | 3.03                                 | 3                                                 |
| 14.00             | 2.80                                 | 2.75                                              |
| 15.00             | 2.64                                 |                                                   |
| 16.00             | 2.44                                 | 2.5                                               |
| 17.00             | 2.32                                 | 2.25                                              |
| 18.00             | 2.17                                 |                                                   |
| 20.00             | 1.97                                 | 2                                                 |
| 22.00             | 1.79                                 |                                                   |



is that proposed by Monoyer who used the term dioptré, or dioptr, D., for a lens of one meter focus 1.00 D. A lens of two meters focus as already stated would have one-half the refractive power, and is designated metrically as 0.50 D. The scale of lenses with their equivalents in English inches and approximate strength of the old system of measuring will be found in the preceding table.

To determine the focal length of a lens in the metric system divide one meter, or 100 centimeters, by the number of D. The focal length of a 4.00 D. lens is  $100 \div 4 = 25$  cm. or 9.84 English inches.

Spectacle lenses are spherical and cylindrical.

*Spherical Lenses.*—These represent either a section of a sphere or two sections of a sphere joined by their plane surfaces. Light passing through a spherical lens is equally refracted in all planes.

*Cylindrical Lenses.*—These represent sections of a cylinder, parallel to its axes. Light passing through a cylindrical lens in a plane parallel to its axis is not refracted, but at all other angles refraction occurs, the greatest amount being when the light passes through at right angles to the axis. The rays are convergent or divergent depending upon whether the cylinder is convex or concave.

*Combination of Lenses.*—When the total case of lenses contains a limited number, combinations may be made. The lens required is obtained by adding the lenses in the combination, which will give the strength for a single lens corresponding to this sum. This will apply to either convex or concave.

*Combination of Convex, +, and Concave, —, Lenses.*—Superimposed convex and concave lenses of equal strength, will neutralize each other, and the vision will be the same as without a lens.

*Combination of Cylindrical and Spherical Lenses.*—A cylindrical lens refracts rays only as the angle deviates from

the axis, and its effect is to increase or diminish refraction in the direction at right angles to its axis. That is, a ray passing through a cylinder in a plain parallel to the axis is not refracted.

The horizontal plane is the *horizontal meridian*, or axis of 180 degrees. The vertical plane, or *vertical meridian* is at an axis of 90 degrees.

In astigmatism, especially when compound, a cylindrical lens will have to be combined with a spherical.

*Visual Angle.*—The apparent size of objects depends upon the size of the *visual angle*. This is formed by lines drawn from the extremities of an object to the nodal point of the eye, which is analogous to the optical center of a lens.

**VISUAL ANGLE IN EMMETROPIA.**—In Emmetropia, Em., the nodal point, is 7 millimeters behind the cornea, and 15 millimeters in front of the retina. The size of the retinal image is directly proportional to the size of the object, and inversely proportional to the distance of the object from the eye.

**RETINAL IMAGE IN AMETROPIA.**—In hyperopia, H., the eyeball is shortened from before backwards, and the retina is correspondingly nearer the nodal point, and the image is smaller; hence hyperopes see objects smaller than the natural size. In myopia the retina is further removed from the nodal point, the eye being longer, and the retinal image is larger; hence myopes see objects larger than normal.

**VISUAL ACUTENESS.**—An object which subtends an angle of  $5^{\circ}$  with the retina of the normal eye is distinctly seen, but if the object is moved farther away, diminishing this angle, the object becomes indistinct on account of the diminution of the visual angle. When the point is reached beyond which the object cannot be seen, the *limit of perception* has been reached.



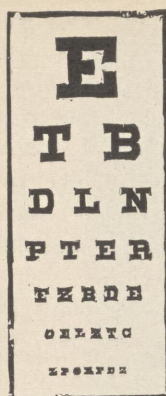


FIG. 105.  
Snellen's Type.

**NORMAL ACUTENESS OF VISION.**—The Snellen tests are most frequently used, each letter subtending an angle of  $5^\circ$ . The strokes of the letter being  $1^\circ$  or 1-5 the size of the letter. Different letters or characters based on this angle are generally employed in testing the vision of patients for distance.

**ACCOMMODATION.**—The shape of the eyeball being comparatively fixed, in order to focus rays from a near object on the retina, some means of accomplishing this must be employed. This depends upon the action of the ciliary muscle and the elasticity of the crystalline lens. The lens being soft in consistency, and enclosed in a capsule, is at-

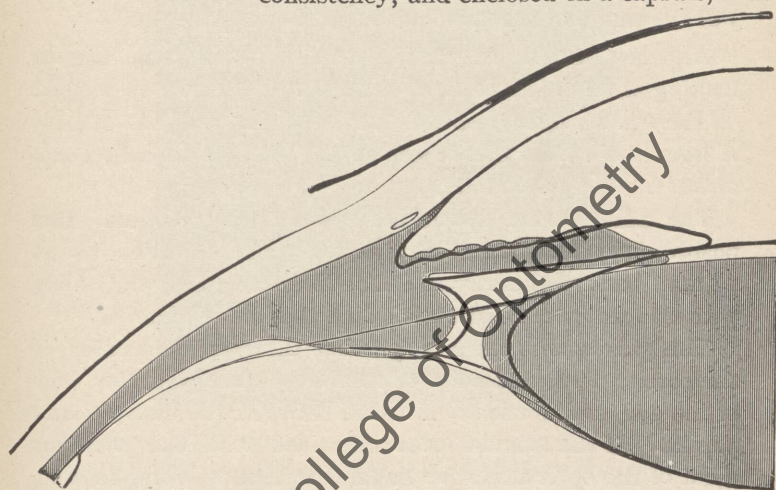


FIG. 106.—Schematic Representation of the Process of Accommodation. The relation of the parts when the accommodation is at rest is designated by the shaded portions, and the relation when there is an effort of accommodation by the black line. The latter shows the ciliary processes and also the equator of the lens pushed toward the axis of the eye. Both surfaces of the lens are more curved, and the anterior surface is pushed forward. The iris is broader, and at its pupillary border is displaced forward; at its ciliary border backward.—Fuchs.

tached by the suspensory ligament to the ciliary body, which has a fixed insertion at the corneo-scleral margin. Contraction of the fibers of the ciliary body relaxes the fibers of the suspensory ligament. The tension of the lens is lessened, and the lens substance having a tendency to assume a spherical form, becomes more convex. The far point of the eye, *punctum remotum*,  $r$ , is the point from which the rays are nearest parallel and are focused on the retina without any accommodative action,  $R$ .

The near point, *punctum proximum*,  $p$ , is the point from which the most divergent rays can be focused on the retina. This requires the extreme accommodative action,  $P$ .

The *range of accommodation*, (*power or amplitude of accommodation*), is understood as meaning the difference between the refractive power of the eye for its remote and near point. For the range of accommodation see table, page 15.

ANGLE GAMMA: ANGLE ALPHA.—Normally the eye in looking at an object is directed so that the image is formed on the *macula lutea*, and the eye is said to "fix" the object. A line drawn from the object to the macula is called the *visual line*, or *visual axis*.

The point about which the eye rotates to obtain this position is called the *center of rotation*, and is located about 14 mm. back of the cornea. The line connecting the object with the center of rotation is called the *line of fixation*.

The *optic axis* is the line passing through the center of the cornea, lens, and point of rotation, to the posterior pole of the eye, and is usually situated between the macula and papilla. If the macula lutea coincided with the posterior point of the optic axis, the visual line, line of fixation, and optic axis would coincide, but this seldom occurs.

In emmetropia or hyperopia the optic axis is to the inner side of the macula, the visual line and line of fixation forming angles with the optic axis. The angle formed by the line of fixation with the optic axis is termed, *angle gamma*. In divergent strabismus this angle should be considered,



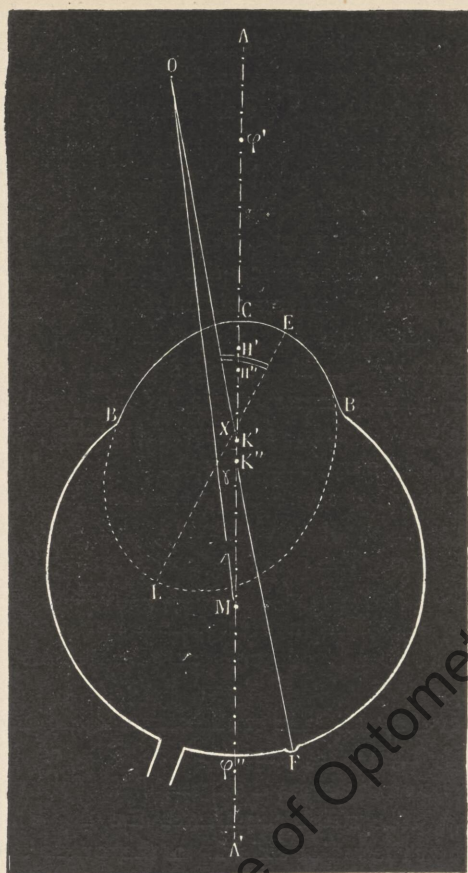


FIG. 107.—Angle Alpha and Angle Gamma. (Landolt.) A A, optic axis; O F, visual line; O M, line of fixation; E L, major axis of corneal ellipse. The line of fixation does not correspond with the optic axis, but forms the angle O M A, angle gamma nearly equal to the angle O X A, formed by the visual line with the optic axis. O X A may be considered as the angle gamma. The visual line does not pass through the summit of the corneal curve, E, but forms with the axis of the cornea, E L, the angle O X E, the angle alpha.

When the anterior portion of the visual line is to the inner side of the optic axis, as usually found in emmetropia and hyperopia, the angle gamma is positive, or  $+$ . Convergence of the visual line exceeds that of the optic axis by the amount of this angle. The visual line and optic axis coinciding, the angle gamma is absent. In high degrees of myopia the visual line occasionally is to the outer side of the optic axis, and the eye must deviate inwards in order to fix an object, which will produce the effect of a convergent strabismus. If convergent strabismus is present, the amount of this angle must be deducted from the apparent convergence. In this form of the angle gamma, the angle is negative, or  $-$ , as the anterior portion of the visual line is outside the optic axis, and the convergence of the visual line is less than that of the optic axis by the amount of this angle.

This angle may be measured by the use of the perimeter, having the eye fixed at the central point, and moving a lighted candle along the arm in a horizontal direction until its reflection is seen from the portion of the cornea corresponding to the pupillary center. The location of the candle on the arc can be read in degrees, and denotes the size of the angle gamma.

It is seldom that the apex of the cornea coincides with its center, usually being displaced to one side or the other. The major axis of the corneal ellipse,  $E L$ , forms an angle with the visual line which constitutes the *angle alpha*. It is *positive* when the major axis is to the outer side of the visual line, and *negative* when it passes to the inner side of this line.

CONVERGENCE. The fovea centralis being the most sensitive part of the retina, the eye is directed normally towards an object in such a manner as to have the image formed at this point, that is the eye fixes the object.

In distinct vision it is necessary that the two images are formed on identical points of the retinas. The foveæ of the two eyes being identical points, images formed on them



will be projected outwards, overlying or fusing into each other. Points at corresponding distances in any direction are also identical, and single vision will result. An object in the field of vision to the right of the point of fixation forms a retinal image to the left of the fovea. The images formed on the retina to the right of the fovea are projected outwards to the left, and those on the left of the fovea to the right. The same rule holds in any part of the retina.

In looking at a distant object, with the axes of the eyes parallel, the images are formed on corresponding portions of the retinas, but if the object is near the eyes, they must be turned inwards on account of the normal separation of the eyeballs, and this turning inwards is termed *convergence*, and is controlled by the interni muscles. Accommodative action of the ciliary muscle is very closely associated with that of convergence, and neither action can be exerted to any extent independently.

The angle of convergence is understood as the angular deviation of the visual line when the eyes are directed at a near object. The unit of convergence is the angle through which the visual lines move to fix on a point one meter distant, and is called one-meter angle of convergence. (Nagel).

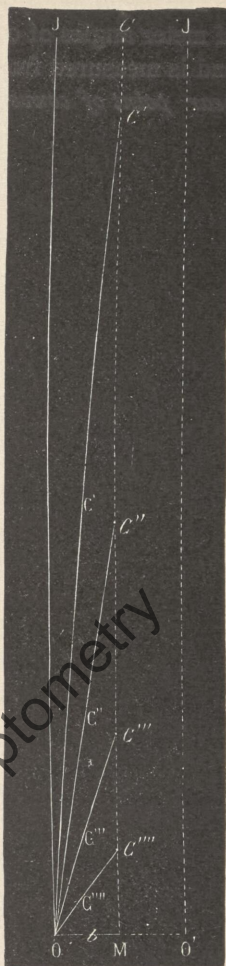


FIG. 108.—Meter Angles of Convergence.

The *amplitude of convergence* is understood as the number of meter angles of convergence which the eyes can produce, and is measured from the *far point of convergence* to the *near point of convergence*.



## CHAPTER XX.

### EXAMINATION OF THE EYE.

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FIELD OF VISION.—The visual axis of one eye being directed to a stationary object, the object is termed "fixed," and the outer points contained within a certain area, the size of which depends upon the distance of the fixation point from the eye, can be seen. This space is called the *field of vision*. *Direct vision*, which is understood as pertaining to the macular region, gives the most accurate visual acuity, but all the sensitive portions of the retina will receive visual impressions, which are termed indirect vision.

The limits of the field of vision are ascertained in many ways. A comparative test which may easily be made, is to place the patient with his back to the light, and covering one eye, "fixing" the other at a point directly opposite, on the center on the examiner's face, who should be at a distance of about two feet. The examiner may use his finger, or any small object, moving the object in different directions mid-way between the point of fixation and the observed eye, until the limit of indirect vision is determined. If the observer's eye is normal, the object being equally distant from the two eyes, a comparative estimate of the field of vision can be made, but if the contraction is not marked the method will fail.

Other methods are in use, one of the most convenient being the steel perimeter, which registers the limitation of the field in all angles, but more inexpensive perimeters are in the market.

It will be found that the field of vision is not circular, extending farther outward and downward, and contracted inward and upward.

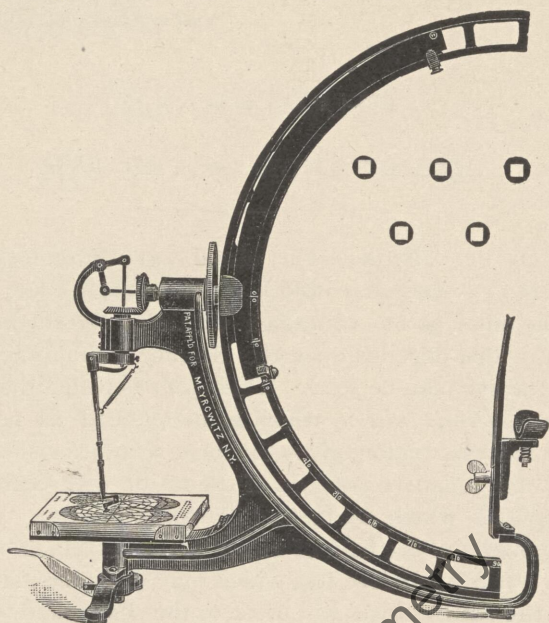


FIG. 109.—Skeel Perimeter. The test object is situated at the extremity of the wedge-shaped carrier. The limit of the visual field is marked on the chart by depressing the lever, which raises the table on which the chart is placed. All angles are readily traced.

**BINOCULAR FIELD OF VISION.**—The field of vision of the two eyes constitutes the portion in which binocular vision is possible, and comprises the area where the central and inner parts overlap. When the *limits* and *continuity* of the visual field have been found, the peripheral portions may be examined for color perception, acuity of vision and light perception.

The *color field* is determined in a manner similar to that already given, excepting that colored objects are used in-



stead of white. The field for colors will be found to vary from that of form. The order in which colors are distinguished from the periphery towards the center is, blue, yellow, orange, red, green, and violet. Blue, red and green are the colors usually employed in the tests, as they are the ones generally affected in morbid lesions.

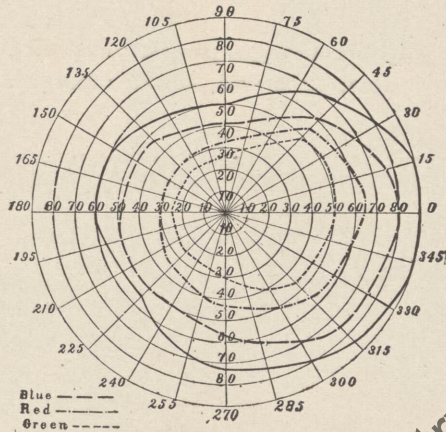


FIG. 110.—Diagram of Color Field, for blue, red, and green. The outer continuous line represents the field for form, white. The broken lines are as indicated.

*Acuity of vision of the peripheral portions of the retina* may be determined by using small squares of black paper, which are separated from each other by intervals equaling their width, and moving them inward to the point where they are recognized as separate objects.

Landolt uses for *perception of light*, a lighted candle passed along the arm of the perimeter. If there is progressive diminution of the light sense from the center to the periphery, it will be found in the majority of cases that some lesion of the fundus is present.

Deviations in the field of vision and scotomas have been spoken of under the proper headings.

REFLECTION OF LIGHT.—Light falling upon a polished surface has a portion of it reflected. The angle of reflection is always equal to the angle of incidence. In examinations of the eye, either plain or concave mirrors are used.

A plain mirror reflects rays without either convergence or divergence, the rays remaining parallel, and appear to come from a point as far back of the mirror as the object is in front.

A concave mirror converges parallel rays of light to its principal focus, forming a *real, inverted* image in front of the mirror.



FIG. 111.—Indirect Ophthalmoscopic Examination.

In the ophthalmoscope either a plain or concave mirror is used. The direct method of examination has already been given under examination of the eye.

In the indirect method the real, inverted image of the fundus is obtained by interposing a strong convex lens, *object* lens, between the examiner and patient, the lens being held close to the eye of patient. The strength of the object lens is from 15.00 D. to 20.00 D. A clear view of the fundus will be obtained when the object lens is held the proper distance from the observed eye and with a convex lens of 5.00 D. in the ophthalmoscope, and varying the distance



from the eye of the patient, but it requires more practice to get a good view than by the direct method. The details of the fundus appear smaller in the direct method although more of the fundus is visible.

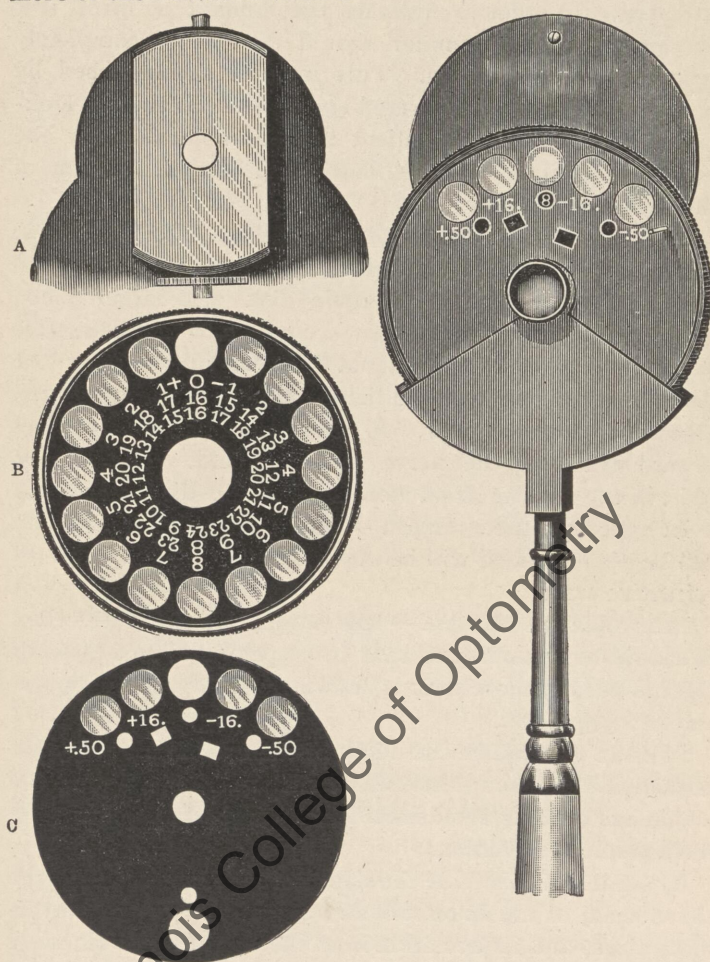


FIG. 112. Loring Ophthalmoscope. A, tilting mirror. B, revolving disk with lenses. C, quadrant with four lenses; when these lenses are not needed they are rotated to the lower part of the body of the instrument.

Both methods of examination should be employed until one is familiar with the appearances of the eye.

DETERMINATION OF REFRACTION WITH THE OPHTHALMOSCOPE.—In order to estimate the amount of error, it is necessary that the examiner should be able to completely relax the accommodation. This may be accomplished by practice, having the uncovered eye directed as though looking at a distance. The patient may be able to relax the accommodation by looking toward the farthest portion of the darkened room.

The ophthalmoscope should be brought as close as possible to the observed eye in the direct method, keeping the pupil steadily illuminated. The optic disk and larger blood vessels will be distinctly seen according to the refractive state of the eye, but it should be remembered that the patient should not look into the mirror, thus bringing the macular region into view. A deviation of about 15 degrees inward will bring the nerve into the field. The line of light in the smaller blood vessels should be distinctly seen.

In hyperopia the strongest  $+$  lens with which these lines can be distinguished will be approximately the measure of refractive error.

In myopia the weakest  $-$  lens would be the correction. It should be remembered that in hyperopia the degree of error is usually more than is shown by the ophthalmoscope, and in myopia less.

In order to estimate the depth of the eyeball, not only for refractive, but also for morbid conditions, Nettleship's table which has been modified from Knapp's, gives approximately the amount of deviation.

By means of this table the depth of an excavation in the nerve head, or the amount of swelling of the papilla, may be recognized and its deviation from the normal approximately estimated.



| HYPEROPIA, H.  |       |         | MYOPIA, M.      |      |         |
|----------------|-------|---------|-----------------|------|---------|
| 1 D shortening | ..... | 0.3 mm. | 1 D lengthening | .... | 0.3 mm. |
| 2 " "          | ..... | 0.5 "   | 2 " "           | .... | 0.5 "   |
| 3 " "          | ..... | 1 "     | 3 " "           | .... | 0.9 "   |
| 5 " "          | ..... | 1.5 "   | 5 " "           | .... | 1.3 "   |
| 6 " "          | ..... | 2 "     | 6 " "           | .... | 1.75 "  |
| 9 " "          | ..... | 3 "     | 9 " "           | .... | 2.6 "   |
| 12 " "         | ..... | 4 "     | 12 " "          | .... | 3.5 "   |
| 18 " "         | ..... | 6 "     | 18 " "          | .... | 5 "     |

SKIASCOPY (Retinoscopy, Shadow Test).—This is the method for determining the refraction of an eye by the use of a mirror, noting the direction in which the light appears to move across the pupil when the mirror is rotated.

The room should be darkened as for an ophthalmoscopic examination.

With the ophthalmoscope, on looking into a myopic eye when close to it, an erect image of the fundus is obtained, which can be made distinct by the use of a proper concave lens; or an inverted image of the fundus, either with or without the intervention of a convex lens, can be obtained by moving farther from the observed eye. The *point of reversal* is the point where the change from an erect to an inverted image occurs.

In skiascopy, the examiner is at a distance of about one meter from the patient, and holding a mirror in front of his own eye, reflects on the patient's face the light from a light placed near the examiner, when using the plain mirror. The light should be covered with an opaque shade with an aperture of one centimeter in diameter. The light should be behind the patient when using a concave mirror.

Rotation of the mirror will cause movement of the area of light on the face of the patient corresponding to the motion of the mirror. When the light is thrown on the pupil it is condensed on the retina, forming an area of light which moves as the mirror moves, with the light on the face, but with a concave mirror it moves opposite the light on the face.

A study of the diagrams will show the principle of the movement of the light.

In the following directions the use of a plane mirror is understood. If a concave mirror is employed it must be remembered that the movement of the light on the pupil is in an opposite direction.

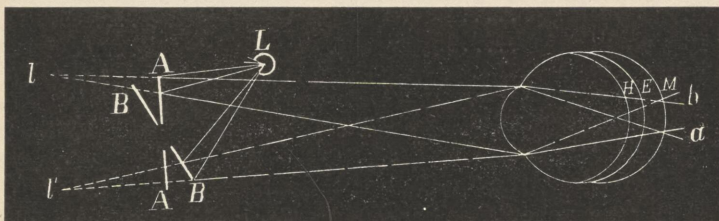


FIG. 113.—Sciascopy with a plane mirror.  $L$ , position of light.  $AA$ , position of mirror in which the light enters the eye apparently from  $L$ , and the focal point is toward  $a$ .  $BB$ , mirror rotated and the light enters the eye as from  $L'$ , being focused toward  $b$ .  $H$ , hyperopia.  $E$ , emmetropia.  $M$ , myopia.

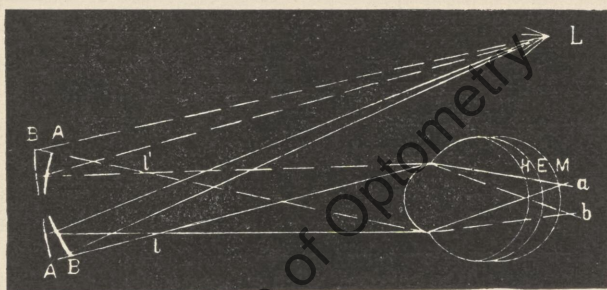


FIG. 114.—Sciascopy with a concave Mirror.  $L$ , position of light. The focal points are reversed from Fig. 113.

The *brightness*, *form* and *rate of movement* are to be taken into consideration, as well as the direction and movement of the light and shadow. At the point of reversal, a single point of the retina appears to occupy the entire pupillary space, while a variation from this point will show an increased amount of the retina in the pupil. When near the



point of reversal a slight movement of the mirror will cause the light to entirely cross the pupil, the light and shadow moving rapidly, but at a distance from this point the light and shadow move more slowly.

In hyperopia, without a lens in front of the examined eye, the light moves across the pupil with the mirror. A convex lens which overcomes the hyperopia will give a point of reversal. The examiner, by varying the distance from the patient, tries the movement of the light and shadow from within the point of reversal, when the movement will be with the mirror, and from beyond the point of reversal, when the movement will be against the mirror. This will determine the point of reversal, and the distance from the point of reversal to the eye is measured or estimated.

MYOPIA.—In a myopic eye, excepting of low degree when a weak convex lens will have to be used, and then subtracting the strength of this lens from the myopia found, the point of reversal can be determined without the aid of a lens. Ordinarily this point is too close to the eye for determination, and a concave lens which partially corrects the myopia should be interposed, measuring the remaining myopia in the manner already described, and adding this to the strength of the interposed lens for the total amount of error.

EMMETROPIA.—This condition is shown when the convex lens before the eye gives the point of reversal at the focal distance of the lens.

REGULAR ASTIGMATISM.—In regular astigmatism the emergent rays will have different degrees of divergence or convergence in different meridians. For the two principal meridians there are always two separate points of reversal, and the distance between them indicates the amount of astigmatism.

When the point of reversal is found in regular astigmatism, it is only for movement in one direction, and the ex-

aminer at this point will see the retina magnified in the direction of the one meridian, and less in the direction of the other principal meridian, the light area having a *band-like appearance*.

After the determination of the principal meridian in astigmatism, the hyperopia or myopia is determined as in a simple hyperopia or myopia. When this has been determined, the difference of refraction between the two meridians is the amount of astigmatism, and with the combination of a cylindrical and spherical lens placed before the eye, the test should be repeated, to determine whether the proper correction is obtained.

Another method for testing astigmatism and obtaining the angle, is by the means of the ophthalmometer. This instrument measures the curvature of the cornea. Any irregularity in this curvature will show, as well as the axis of the astigmatism.

The method of using the ophthalmometer is to have the front of the instrument strongly illuminated, the face of the patient being in comparative shadow, the chin placed on the rest provided for that purpose, and the forehead resting firmly against the head piece. The eye is covered with a shade and the patient directed to look into the barrel of the telescope. The instrument is adjusted to the proper height by means of an adjusting screw, and focused by moving the telescope standard back and forth until the corneal images are distinct. On looking through the telescope, when properly focused, the mires of the instrument should be so adjusted as to just touch each other in one of the principal meridians.

The black line across the mires should be continuous. Having the patient open the eye as widely as possible, and looking steadily into the instrument, observe whether the mires are still just touching. Now by revolving the telescope on its axis, if there is no astigmatism, the mires will be in contact in any position in which the arms may be placed.



When astigmatism is present, the lines will cease to be continuous, and the mires will separate or overlap, depending upon the form and amount of the astigmatism. The stepped mire gives for each step one D. of astigmatism.

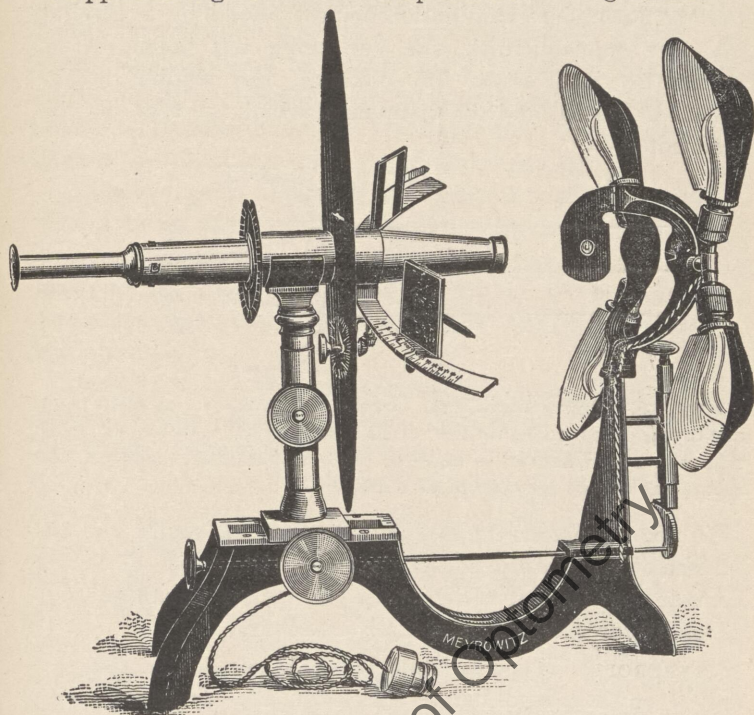


FIG. 115.—Ophthalmometer.

This method will readily determine the angle of the astigmatism and approximate the amount, and as an aid in diagnosis is of considerable value.

*Subjective Method of Correcting Refractive Errors. The Trial Case.*—This is the method which will have to be relied upon in a great majority, while the other methods are useful as corroborative tests. The trial case should contain, as already given, a series of lenses sufficient for all cases,

but smaller cases may be used in which combinations of lenses will enable one to determine the lens required.

Test letters are employed and should be in good light, either natural or artificial. Each eye should be tested separately. the eye not under examination being covered by a ground glass, or an opaque disk, the eye being left open. After noting the visual acuity for distance, the reading power should be tested, and the distance at which the type can be read noted.

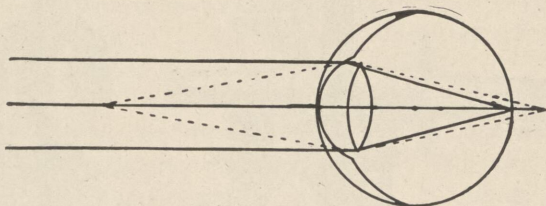


FIG. 116.—Emmetropic Eye. Parallel rays shown by solid lines are brought to a focus on the retina. Divergent rays from a point near the eye, when in a state of rest, are focused back of the retina, as shown by the dotted lines.

In young persons the eye should be placed under the influence of a mydriatic before the final adjustment of lenses is made, but for determining the refractive condition and necessity for glasses this is rarely necessary.

**HYPEROPIA (Hypermetropia).**—In hyperopia, H., the eyeball is too short from before backward, the principal focus of the eye being behind the retina.

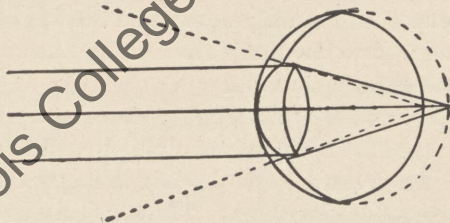


FIG. 117.—Hyperopic Eye. Parallel rays focus behind the retina. Convergent rays focus on the retina.



CAUSES OF HYPEROPIA.—As a rule it is an *axial hyperopia*, a shortening of the globe from before backward, as all the diameters of the eyeball are shorter than normal. *Curvature hyperopia* is found in some cases, the cornea or lens is flattened. *Aphakial hyperopia* results from loss of the lens, either operative, accidental or as a congenital defect. At birth the condition is nearly always that of hyperopia. With the development of the body, the eyeball has a tendency to increase in length, the hyperopia diminishing and may pass into emmetropia, or possibly into myopia.

*Symptoms.*—In hyperopia it is difficult to see small objects distinctly for any length of time, the objects fade, and the patient is compelled to stop using the eyes and frequently will rub them. This may temporarily relieve the condition and clear vision result, but eventually the work must be discontinued.

Disposition to hold small objects in a strong light is often present. The pupils are usually contracted. Children may hold their books close to the eyes, and contracting the lids be able to see more distinctly than when the reading is held at a normal distance, as the visual angle is increased in size. This condition simulates myopia and not infrequently concave lenses have been fitted under the impression that they were myopic. This will sometimes apparently give clearer vision for a time, but eventually increases the difficulty.

Spasm of the muscles of accommodation is very frequent in hyperopia, on account of the strong contraction of the ciliary muscle endeavoring to overcome the error. The distant vision in these cases is often very deficient, and again we may find the patient wearing myopic lenses. Spasm of the accommodation may occur also in neurasthenic patients, the spasm being out of proportion to the hyperopia.

Conjunctivitis, blepharitis, retinal and choroidal congestion and sometimes hyperemia of the papilla may be complications. *Constant headache*, increased on use of the eyes; nervous symptoms, reflex in character, as well as

visual disturbances are often found in these cases. Convergent strabismus is almost always associated with hyperopia. Donders divides hyperopia in *manifest* and *latent*. The manifest is correct by the strongest convex lens through which the eye obtains distinct distant vision, without the employment of a mydriatic. Latent is the amount which is in excess of the manifest, and is developed under the influence of a mydriatic. The sum of the manifest and latent form the *total hyperopia*.

*Diagnosis.*—Hyperopia is present when distant vision is improved by a convex lens; when fine print can be read through a convex lens at a greater distance than its focal length; when with the ophthalmoscope the fundus of the eye is normal, but is most distinctly seen with a convex lens. As a rule also the near point is at a greater distance from the eye than it should be for the age.

Any of these symptoms being present will indicate the necessity for a mydriatic. Ordinarily mydriatics are not required after the age of fifty, and usually not after forty, but in some instances it will be necessary. A young person with an excessive amount of spasm of the muscles of accommodation, or when there is congestion of the choroid, may have to use a mydriatic for some time.

*For correcting hyperopia a convex glass which will give the best visual acuity should be employed.*

The patient is placed as for the preliminary examination, one eye being covered. The smallest letters which can be read on the test card should be noted. By comparing this with the result obtained before the mydriatic was employed, will give an approximate idea of the amount of error. A good rule in working with cases, even under a mydriatic, is to first place in the trial frame a stronger convex lens than the previous examinations show to be required, still further diminishing the range for distant vision; then by holding in front of this lens, a minus lens, or changing from the stronger to a weaker lens, the vision will gradually im-



prove until the full acuity is reached, unless astigmatism is present. When astigmatism is absent convex lenses will be sufficient to correct the error.

The lens obtained under the mydriatic, under ordinary circumstances should not be prescribed, as it will be the full correction, and the patient will be unable to wear the glasses with comfort, especially for distant vision. After the effect of the mydriatic has disappeared, and before the eyes have been used for close work, another test should be made and the correcting lens given. The strength of this will depend upon the amount of hyperopia, from 0.25 D. to 0.50 D. less than full correction as a rule, but cases are often found where the degree of error is so great that a much weaker lens will have to be given to start with. If the lens accepted is out of proportion to the full correction, one of three methods may be employed; one is to give the theoretical glass, and allow the muscles of accommodation to gradually accustom themselves to it; to use a weak mydriatic to aid in the relaxation of the muscle, which has returned to its abnormal condition: or, as stated, to give as strong a glass as the patient will accept, changing later to a stronger lens after some of the latent error has become manifest.

Where it is impossible for a patient to go under the influence of a mydriatic, it will be necessary to use the fogging method, that is, placing a lens which is in excess of the error, in front of the eye, generally about a + 10.00 D. Both eyes should be subjected to this method. In some cases the placing of a two or three degree prism, base in, before the eyes, will also aid in relieving the accommodative effort. After the strong lenses have been before the eyes for ten or fifteen minutes there will be marked relaxation of the muscles of accommodation, and weaker lenses may be substituted, but it is always best to work from the stronger to the weaker in hyperopia, as the accommodative power of the muscle is such that the tendency is always to accept a

weaker lens than is required. The rule should be to *give the strongest + lens which will give distinct distant vision.*

MYOPIA, M,—In this condition the eyeball is too long from before backward, and the principal focus of the eye lies in front of the retina.

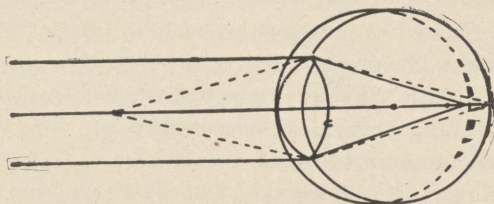


FIG. 118.—Myopic Eye. Parallel rays focus in front of the retina. Divergent rays focus on the retina.

*Causes.*—Curvature myopia may result from an increased refraction of the cornea ; or lens, or by an elongation of the optic axis, *axial myopia*. The latter is the cause in the majority of cases, and in the most of these, the elongation is the result of morbid changes in the tunics of the eye.

Myopia is often progressive, that is, the elongation continues, and the patient requires stronger and stronger lenses.

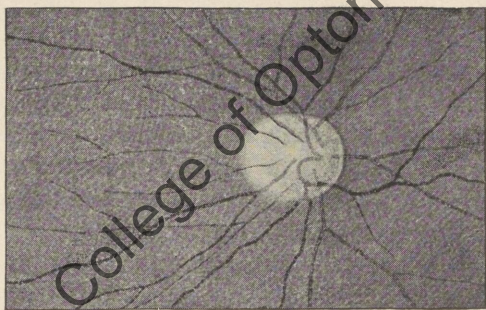


FIG. 119.—Myopic Crescent.

In myopic eyes there is often seen on the temporal side of the nerve a whitish crescentic space, which is called *conus* or *myopic crescent*, which is probably due to a drawing of the



choroid to the temporal side. The papilla is often distorted in the same direction.

Change in the shape of the cornea as in conical cornea, or the result of disease, may also produce myopia.

A number of theories have been advanced to explain the cause of myopia

The mechanical theory, is the one which is the most generally accepted, and will probably account for the majority of cases. It is that the compression of the eyeball by the external ocular muscles has a tendency to elongate the eye backwards, and this being continuous, especially in those who are using their eyes for close work, finally produces a marked elongation.

Stilling and Landolt consider race influence as a factor. A hereditary tendency is also undoubtedly a cause in many cases.

Other conditions which may have an influence, may be unusual pupillary distance, increasing the effort of convergence; divergent strabismus, and spasm of the muscle of accommodation have also been classed as causes.

Myopia is seldom congenital, making its appearance usually after the eighth year.

*Symptoms.*—These may be described as subjective and objective.

The *subjective* symptoms are those which naturally follow on account of the limitation of the visual range. Distant objects are imperfectly distinguished. The patients show a disinclination for out door sports, and are usually found to be studious in their habits, which unfortunately has a tendency to increase the condition. Unless astigmatism is present, headache and the reflex symptoms found in hyperopia are usually absent. Pain in the eyes, lack of endurance, and congestion of the conjunctiva may be present. If the choroid has undergone changes, asthenopic symptoms are found.

*Objective Symptoms.*—In high myopia there may be

prominence of the eyeball ; frequently a dull expression of the face ; in reading the head is moved from side to side following the lines, while the book is held stationary. By the direct ophthalmoscopic examination, the fundus and disk are brought into distinct view by means of concave lenses. In the indirect method, the inverted image may be seen by withdrawing the mirror some distance from the eye. Divergent strabismus is often present in these cases. The deviating eye is frequently amblyopic, and binocular vision in this condition is imperfect. When the visual acuity is much diminished, the use of glasses will not give relief on account of the diminution in the size of print.

A popular fallacy is that myopes have strong eyes, on account of their ability to see fine print when held close to the eyes. This may hold in cases where the tunics have not suffered any degeneration from elongation.

The tendency of myopia is to increase, often until middle life.

**MALIGNANT MYOPIA.**—In the higher degrees of myopia, marked changes in the structure of the choroid and retina are found, the pigment cells are displaced in some portions, and more numerous than normal in others. Glistening white atrophic areas may be found interspersed with black pigment, and occasionally hemorrhages are present. The papilla may be surrounded by an atrophic area, *posterior staphyloma*. The vitreous loses its normal consistency, becoming more or less fluid, and with floating opacities, which may be so large and numerous as to obscure vision.

In myopia of 15 D. to 20 D., the morbid process may result in retinal detachment and total blindness.

The ciliary body is not well developed in myopia of high degree, consequently the accommodation is diminished, and the anterior chamber large. It is claimed that glaucoma in myopic eyes is not so frequent on this account.

*Diagnosis and Correction of Myopia.*—The position of the *punctum proximum* or near point, being closer to the eye



than normal; the *punctum remotum* or far point, being also nearer the eye than it should be; by the ophthalmoscopic and retinoscopic examination; improvement of distant vision by the use of concave lenses.

In low degrees of myopia, the position of the glass in front of the eye is not so important, but in the higher grades it must be as close to the eye as possible, and care must be exercised that a too strong lens is not prescribed. The tendency of the patient is to select a stronger lens than the amount of myopia requires, as distant objects are often rendered more distinct.

*The weakest concave lens which renders the visual acuity good should be prescribed.*

When astigmatism is absent, the glass ordered must be suitable for the character of work required. Under the age of twenty, with fair vision, and a myopia of 5.00 D. or less, the full correction may be worn constantly in the majority of cases. In myopia of over 5.00 D. with lowered visual acuity, the full correction cannot always be worn, and from 1. to 2.5 or 3. D. less may have to be prescribed.

With advanced years a still weaker lens may be required for close use of the eyes.

In young persons with normal visual acuity and binocular vision for close work, full correction should be given, but care must be exercised not to over correct. When the visual acuity is diminished, or binocular vision impossible, a partial correction is advisable for near work.

The nearer the concave lens is to the cornea, the stronger is its refractive power, and the further removed, the weaker. Concave lenses diminish the size of the retinal image. In myopia the retinal image is larger than in emmetropia, but when the proper correcting lens is exactly 13 millimeters in front of the cornea, the image is the same as in emmetropia. As there is a strong prism action in concave lenses, it is necessary that the optical center of the lenses should be separated by a space equal to the pupillary distance. It never should

be less, excepting where weakness of the interni muscles requires prism action.

ASTIGMATISM (As.).—By astigmatism is understood a refractive condition of the eye, in which a luminous point, as a star, forms on the retina either a line, an oval, or a circle, but never a point.

This is usually the result of an unequal curvature of the cornea, but in some cases the lens may be the irregular surface. This variation in curvature gives different refractive foci to the eye. There are three types of astigmatism: An eye may be emmetropic in one meridian, and either hyperopic or myopic in the other.

An eye may be hyperopic or myopic in all meridians, but the degree may differ.

An eye may be hyperopic in some meridians and myopic in others.

Rays passing through the cornea in the meridian of highest refraction are focused first, while the focus of the least refractive meridian is further back.

Astigmatism may also be regular or irregular. When the meridians of curvature progress evenly from the lowest to the highest it is *regular*, but when there is an irregularity in the curvature in different portions of the same meridian, it is termed *irregular*. This condition may result from corneal ulcers, cicatricial tissue, or inflammatory action of the cornea.

A slight irregular astigmatism is usually present in all eyes, but does not produce any inconvenience.

*Principal Meridians.* In regular astigmatism, one corneal meridian will have a shorter radius of curvature than the meridians at right angles, which will have the longest radius of curvature. The shortest radius has the highest refraction, and the longest radius the least refraction. These two are called the *principal meridians*, and may be situated in any part of the cornea, but as a rule the tendency is for the highest refractive meridian to assume the vertical position, or an



axis of 90 degrees, and the least refractive a horizontal position, or an axis of 180 degrees.

Astigmatism *with the rule* is understood when the axis is vertical or nearly so, but when the axis of greatest refraction approaches the horizontal, it is *contrary to* or *against the rule*.

Astigmatism in which the principal meridians approach 45 degrees and 135 degrees is termed *oblique*.

FORM OF IMAGE IN ASTIGMATISM.—In the description following it will be understood that the principal meridians are perpendicular and horizontal, the greatest refraction being in the vertical.

Rays entering an astigmatic eye are most sharply refracted by the vertical meridian, forming a horizontal oval, which diminishes in size as the rays pass further backwards. The vertical diameter of the oval lessens rapidly, until the focus of the vertical meridian is reached, when the figure is a horizontal line. Passing beyond this line the rays diverge vertically, becoming again a horizontal oval. Still more remote the figure becomes a circle, but is not distinctly outlined. Further progression backwards, the figure assumes a vertical oval, and eventually a vertical line, which is the focus of the horizontal meridian. On account of this refractive condition a distinct image is never formed on the retina.

*Symptoms.*—Visual acuity is diminished, and there is a disposition to confuse letters, B and S, K and X, F and P, V and Y, H and N, C and G. The diffusion areas overlapping in the retinal image, produces in high degrees of astigmatism an apparent doubling of objects.

On account of the indistinctness of vision, objects are held closer to the eyes, thus increasing the accommodative strain. Persons with astigmatism often overcome the defect in a measure by contraction of the lids, producing a horizontal slit of the palpebral fissure which intercepts the

vertical diverging rays, and the eye accommodating for the horizontal rays receives a more distinct but fainter image.

Indistinctness of fine lines running in certain directions is produced in astigmatism. The indistinct lines being determined by the meridian which has its focus nearest the retina. This meridian will be the nearest emmetropic and the lines parallel to it will be indistinct, while the lines parallel to the opposite, or more ametropic meridian, are seen more distinctly.

When the horizontal meridian is emmetropic, fine parallel lines in a horizontal direction will appear as thick bars and the vertical lines will be distinct. Marked asthenopia is often the result of astigmatism, and functional headaches are caused by this condition in a large proportion of cases. The headache may be slight or extremely severe, and may be located in any portion of the head. Many of these symptoms of distress are more marked in astigmatism of low degree, or when oblique, than when the astigmatism is of high degree. It would seem that the muscles of accommodation in the latter condition do not attempt to correct the error, and the patient usually chooses some vocation which does not require close use of the eyes.

REGULAR ASTIGMATISM.—Five varieties of regular astigmatism are given, depending upon the relative position of the retina to the foci.

SIMPLE HYPEROPIC ASTIGMATISM, Ah. or H. As.—In this form the vertical meridian is usually emmetropic, the horizontal being hyperopic. The focus of the vertical meridian being on the retina, and that of the horizontal meridian behind the retina. Horizontal lines distinct.

SIMPLE MYOPIC ASTIGMATISM, Am. or M. As.—The horizontal meridian usually is emmetropic, the focus being on the retina, and that of the vertical meridian in front of the retina. The vertical meridian is myopic, and the horizontal lines appear distinct.



COMPOUND HYPEROPIC ASTIGMATISM,  $H + Ah.$  or  $Co. H. As.$ —Hyperopia of all meridians, but the horizontal generally the most. The foci of the two principal meridians being back of the retina. The vertical usually the nearest. The horizontal lines generally most distinct.

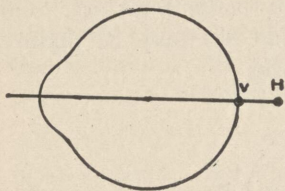


FIG. 129.—Foci in Simple Hyperopic Astigmatism. V, focus of vertical meridian. H, focus of horizontal meridian.

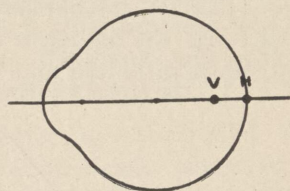


FIG. 121.—Foci in Simple Myopic Astigmatism. V, focus of vertical meridian is myopic. H, focus of horizontal meridian.

COMPOUND MYOPIC ASTIGMATISM,  $M + Am.$  or  $Co. M. As.$  Myopic in all meridians, the vertical usually being the most myopic. The foci of the principal meridians are in front of the retina, and that of the horizontal generally being nearest, vertical lines usually most distinct.

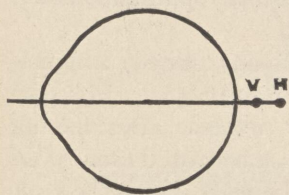


FIG. 122.—Foci in Compound Hyperopic Astigmatism. V, vertical meridian. H, horizontal meridian.

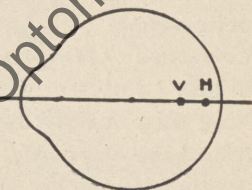


FIG. 123.—Foci in Compound Myopic Astigmatism. V, vertical meridian. H, horizontal meridian.

MIXED ASTIGMATISM, H and M.—The foci of the principal meridians on each side of the retina. The horizontal is usually hyperopic, and the vertical myopic, no lines





Corresponding to the most ametropic meridian, the lines will be the most distinct. The stenopaic slit of the trial case should be placed in the frame perpendicular to these lines. If the meridian is emmetropic the vision will be normal and the astigmatism is simple. Rotate the slit at right angles to its former position, and interpose lenses from the case until the best vision possible is obtained; this will give the amount of the astigmatism. This rule will apply to either simple hyperopia, or myopic astigmatism.

**SIMPLE HYPEROPIC ASTIGMATISM.**—Horizontal lines most distinct; the stenopaic slit vertically placed in the trial frame, that is, at 90 degrees the  $V.=20-20$ ; the stenopaic slit revolved horizontally to 180 deg.  $V.=20-30$ ; 20-20 with  $+1.00$  D. lens. The prescription would read,  $+1.00$  D. cyl. axis, 90 degrees.

In simple myopic astigmatism there would be a reversal of the distinct lines, and the prescription would be  $-1.00$  D. cyl., axis 180 degrees, or 0 degrees.

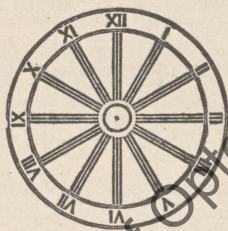


FIG. 125.—Astigmatic Dial.

Frequently the patient will not notice any difference in the lines of the dial until a spherical lens is placed in front of the eye, when some may be more distinct than others. Placing the stenopaic slit at right angles to the distinct lines, such a spherical lens should be used as will give the best vision with the slit in this position, then rotate at right angles to the first position. Visual acuity may be less in this position, and a stronger lens may be required to bring the vision to its best. The amount of the astigmatism will

be the difference between the stronger and weaker lens. This condition is found in compound astigmatism, and the lens prescribed will be a spherical lens the strength of which neutralizes the nearest emmetropic meridian, and a cylindrical lens whose strength is the difference between the two meridians.

Another method frequently employed is to first use such a cylinder as will give an equal distinctness of all the lines in the dial, then adding spherical lenses until the best possible visual acuity is obtained.

COMPOUND HYPEROPIC ASTIGMATISM, Co. H. As. or H + Ah.—All the lines more or less indistinct. A convex lens brings out the horizontal lines. The stenopaic slit at 90 degrees; V.=20-40; 20-20 w. + 1.50 D. Then rotate to 180 degrees; V.=20-60; 20-20 w. + 3.50 D. The lens required to correct the error would be a spherical lens of the weakest number, combined with a cylinder whose strength is represented by the difference between the two lenses or + 2.00 D. cyl. The prescription would read + 1.50 D.  $\odot$  + 2.00 D. cyl., axis 90 degrees.

In compound myopic astigmatism Co. M. As., or M. + Am. the meridians are obtained in a similar manner and the prescription would be - 1.50 D.  $\odot$  - 2.00 D. cyl., axis 180 degrees.

MIXED ASTIGMATISM.—In this type one meridian is hyperopic and the other myopic. The use of the stenopaic slit may be employed here as already directed, only that in one position a concave lens will have to be employed, and in the other a convex lens. As a rule lenses are not ground as cylinders on both sides, crossed cylinders, a + or - spherical bring used for one surface, and a cylinder for the other.

The method of writing a prescription for mixed astigmatism varies according to circumstances: + 1.00 D. cyl., axis 180 degrees  $\odot$  + 2.00 D. cyl., axis 90 degrees, may be written + 2.00 D.  $\odot$  - 1.00 D. cyl., axis 180 degrees, or +



1.00 D.  $\ominus$  + 1.00 D. cyl., axis 90 degrees. The sign  $\ominus$  meaning combined with, is employed in writing for compound lenses.

It is almost an invariable rule in these cases to give full correction for the astigmatism, while the spherical correction is generally less than the full correction. It is always advisable to try two or more methods in order to determine the correctness of the findings.

With a combination of spherical and cylindrical before the eye, if by placing another cylinder of the same sign with its axis at right angles to the cylinder in the frame, it improves the vision, it is evidence that a stronger spherical and a weaker cylinder is needed. When a cylinder of the same sign is placed with its axis parallel to the one in the frame, and an improvement in vision is found, it is evidence that a stronger cylinder is needed. If a cylinder of a different sign, with the axis parallel improves the vision, a weaker cylinder is required. If a cylinder of a different sign is placed with its axis at right angles, an improvement is noted, a weaker spherical and stronger cylinder are needed. As correction of astigmatism can be made with a + cylinder placed with its refracting surface in the direction of the least curved meridian, or with a - cylinder with its refracting surface in the direction of the greatest curve, it allows the examiner some latitude, although theoretically it is proper to give a + cylinder in hyperopic astigmatism, and a - cylinder in myopic astigmatism; for practical purposes it will be found that the reverse of this rule will give the most comfort in some cases.

These rules are applicable in cases where the axis of the astigmatism is at 90 degrees, or 80 degrees, but in cases of oblique astigmatism, although in many cases perfect visual acuity may be obtained with each eye singly, when the two eyes are uncovered, giving binocular vision, the acuity is diminished and in some instances the patient will be unable to wear the glasses with comfort.

According to Savage, the following rule is applicable in the majority of these cases. "*In those cases in which the axes of the proper convex cylinders for the two eyes diverges, place the cylinders at those points which will give the axes the greatest divergence permitted by the tests; and in those cases in which the axes converge, place them at the points which will give them the greatest convergence permitted by the tests.*"

In oblique myopic astigmatism, the axes of minus cylinders are placed by changing *least* for *greatest*, and *vice versa*. As in all rules there are exceptions, the judgment of the examiner must be used in prescribing the lenses.

The same general rule holds in ordering glasses for astigmatism as for simple spherical errors, remembering that the cylinder should if possible be the full correction.

IRREGULAR ASTIGMATISM.—A slight degree of irregular astigmatism is present in the majority of eyes, but it does not interfere with the visual acuity. In cases of marked irregularity of the corneal surface, resulting from ulcers and cicatricial tissue, the reduction of vision is usually marked. In some cases, one meridian of regular curvature may be found, when a cylindrical lens may improve the vision. Occasionally an iridectomy, by bringing the artificial pupil back of the most regular portion of the cornea, may be followed by improvement, but in the majority little improvement can be obtained.

ANISOMETROPIA.—This term is applied to those cases in which the refractive condition of the two eyes varies. One eye may be myopic and the other hyperopic. In some cases both eyes can not be fully corrected on account of the difference in the refractive power of the lenses. As a rule, some improvement will follow the careful adjustment of lenses correcting the error of each eye. Occasionally it may be necessary to exercise the one eye by excluding the other for a short time; this exercise should be performed several times a day.



**PRESBYOPIA.**—The power of accommodation gradually diminishing from childhood, carries the near point further from the eye until the near point is at such a distance that fine type cannot be read without the use of a convex lens. This is known as presbyopia and is not an abnormal condition.

*Causes.*—It results from hardening of the lens, which reduces its elasticity so that it cannot become more convex by accommodative effort.

A person with emmetropia may be able to use the eyes for close work as late as the age of forty-five, but the average age appears to be about forty for those who are using their eyes pretty steadily for close work. As the power of accommodation rapidly diminishes after the age of forty, and up to the age of seventy-five, when it is practically destroyed, the lenses will have to be changed from time to time, usually every two and a half or three years. After seventy-five, however, it is rarely necessary to change the reading glasses, and objects will be held at the focus of the lens.

As a rule, in presbyopia an increase of 1.00 D. will be found for every five years after the age of forty.

**CORRECTION IN PRESBYOPIA.**—In this condition the eyes should be tested in a similar manner to that already described, and any error of refraction should be corrected, rendering the eye emmetropic. This will give distinct distant vision, but it does not materially improve the near vision.

A presbyopic glass brings the near point closer to the eye, but diminishes the distinctness for the far point. Care should be observed in fitting these glasses that a too strong lens is not given, as the discomfort produced may be considerable. The near point should be determined for each eye separately, but the occupation of the patient will modify the strength of the lens in a measure, as some are compelled to work at a greater distance than is ordinarily considered normal.

After the correction of any hyperopia or astigmatism, it is usually not difficult to obtain the proper glasses. The broad rule of adding 1.00 D. for every five years of age after the age of forty will be correct in a large proportion of cases after the correction of the hyperopic astigmatism. In some instances it may be necessary to use a slightly stronger or weaker glass. The vocation of the patient governing the correction.

In myopic patients this rule cannot be followed. With a myopia of not more than 2.00 D. reading glasses will not be necessary at as early an age as in emmetropia or hyperopia. With a myopia of 2.00 D. the age of fifty or fifty-five, or possibly even more, may be obtained before the necessity for reading glasses will be noticed. At fifty-five possibly a +0.50 D. will give better visual acuity for close work, but it is unusual that a +1.00 D. is required at this age, though cases are found.

A myopia of 3.00 or 4.00 D. will not become presbyopic, as ordinarily understood, and seldom will require a glass for reading. In early life the proper correction will be used for both distance and reading, but after the presbyopic age the patient will see better without any reading glasses, although correction may be necessary for distant vision.

When the myopia is of high degree, it may require a concave glass, ranging from 2.00 D. to 5.00 D. less than the full correction, for reading. In these cases the accommodative power being slight, if any, age does not have as much influence in the reduction of vision with advancing years as in hyperopia or emmetropia. Such lenses as give comfort to the patient will be the ones to give, as a rule.

Prisms combined with lenses are often necessary in order to give the patient comfort in the use of the eyes, but decentering of the lenses will sometimes give the necessary relief. When simple myopic astigmatism is present and the presbyopic period is reached, a + cylinder of the same number, the axis being at right angles to the myopic meridian, may



be sufficient to give good reading vision. In case the myopic astigmatism is considerable, a concave spherical may have to be combined with a  $+$  cylinder in order that the glasses may be used with comfort.

It must be remembered in all cases of refraction that no hard and fast rules can be given, but that each case must be treated independently, and the successful results obtained by the physician will be in proportion to his ability to differentiate and treat each individual as though it was the first case worked upon.

ON THE PROPER ADJUSTMENT OF LENSES.—It is very important in cases requiring glasses, especially in astigmatism, or where the lenses required are strong, that they be properly adjusted to the individual case. Before the patient is allowed to wear the glasses prescribed, they should be carefully tested to find whether the proper lenses have been given, and the position on the face should be noted regarding the pupillary distance, the distance from the eyes, as well as the inclination of the glasses, which will vary according to the use for which they are intended.

For determining the refraction of the lenses, the lens measure is the most convenient, as it will give the strength of the sphericals and cylindricals quickly. In the absence of the lens measure, by taking from the trial case the same strength lens of the opposite sign, and placing it over the prescribed lens, being careful to get the optical centers opposite, the correctness of the work can be determined. By observing some distant object through the combination, which should be moved in different directions, observe the object closely, and if no motion is observed it will indicate that the lenses neutralize. If through the combination the object should move against the motion, it will show that a  $+$  or convex lens preponderates, but if the motion is with the motion of the combination a  $-$  or concave strength is in excess. The difference in the strength of the lenses is determined by the lens from the trial case necessary to produce a

stationary effect of the object on movement of the combination.

This rule will hold for cylinders, as well as spherical lenses, but with very strong bispherical lenses this rule will not hold, as the convex lens will always be in excess. With plain cylindrical lenses, objects will not move when the lens is moved in the direction of the axis, but at right angles to this there will be motion with or against, depending upon the form of the lens. It is best in cases of cylinders to take some object, such as the sash of a window, or edge of a door, when by moving the lens in different directions the straight lines will be broken in some particular direction.

A combination of spherical and cylindrical lenses can be tested in the same way by using both spheres and cylinders of opposite signs, and having the axes of the cylinders coincide.

After determining the accuracy of the lenses, the frames should be placed on the patient's face, and the center of the lenses in their relation to the pupils carefully noted. If the lenses are to be used for distant vision, the patient should look through the center of the lenses. In convergence, as for looking at near objects, it will be noticed that the center of the pupils is inside the center of the lenses. In glasses for constant use, as ordinarily in persons under the age of forty, the pupillary distance of the lenses should coincide with the pupillary distance of the eyes, but the lenses may be slightly tilted, but not to the same extent as for reading glasses.

Glasses to be worn for close work only, should have the pupillary distance less than those for distant vision, and also drop lower on the face, so that the center of the pupils coincides with the optical centers of the lenses for close work, and the tilt of the frames should be such that the eyes can be used without holding the work too high or inclining the head too much, either of which conditions will



be uncomfortable. The rays of light should fall nearly perpendicularly on the lenses.

The distance of the glass from the eye is important, as it will change the refractive power of the lens. Lenses should be far enough away so that the lashes do not touch the glass; the position however, must be as close to the cornea as possible to avoid this annoyance. An improperly fitted frame, instead of relieving the patient from the annoying line of symptoms, will probably increase them, and too little attention as a rule is paid to the adjustment of frames. In astigmatic cases, especially oblique astigmatism, a very slight deviation of the lenses from the required angles will materially increase the discomfort. Spectacles are the best in astigmatic cases, although the popular prejudice against spectacles and in favor of the eye glasses, will often make it impossible to prevail on the patient to wear the lenses in proper frames. In simple spherical errors, provided the pupillary distance of the lenses is correct, it does not ordinarily make as much difference regarding the kind of frames used. In some cases where a prism effect is required, it can be obtained by decentering the lenses, and Dr. E. Jackson's table with his descriptions are given.

*Decentering required to produce a given deviation.*

| DEVIATION REQUIRED.              |        |      |        |      |        |      |      |      |  |
|----------------------------------|--------|------|--------|------|--------|------|------|------|--|
| Lens.....                        | 0.5°d. | 1°d. | 1.5°d. | 2°d. | 2.5°d. | 3°d. | 4°d. | 5°d. |  |
| AMOUNT OF DECENTERING NECESSARY. |        |      |        |      |        |      |      |      |  |
| 1 D.....                         | 8.7    | 17.5 | 26.2   | 34.9 | 43.6   | 52.4 | 69.9 | 87.5 |  |
| 2 " ...                          | 4.3    | 8.7  | 13.1   | 17.5 | 21.8   | 26.2 | 34.9 | 43.7 |  |
| 3 " ...                          | 2.9    | 5.8  | 8.7    | 11.6 | 14.5   | 17.5 | 23.3 | 29.2 |  |
| 4 " ...                          | 2.2    | 4.4  | 6.5    | 8.7  | 10.9   | 13.1 | 17.5 | 21.9 |  |
| 5 " ...                          | 1.7    | 3.5  | 5.2    | 7    | 8.7    | 10.5 | 14   | 17.5 |  |
| 6 " ...                          | 1.5    | 2.9  | 4.4    | 5.8  | 7.3    | 8.7  | 11.6 | 14.6 |  |
| 7 " ...                          | 1.3    | 2.5  | 3.7    | 5    | 6.2    | 7.5  | 10   | 12.5 |  |
| 8 " ...                          | 1.1    | 2.2  | 3.3    | 4.4  | 5.4    | 6.5  | 8.7  | 10.9 |  |
| 9 " ...                          | .9     | 1.9  | 2.9    | 3.9  | 4.8    | 5.8  | 7.8  | 9.7  |  |
| 10 " ...                         | .9     | 1.7  | 2.9    | 3.5  | 4.4    | 5.2  | 7    | 8.7  |  |

—DeSchweinitz.

The first column gives in diopters the strength of the lens to be used. At the head of each of the other columns is given the prismatic deviation required. The method of obtaining this is pointed out below. The columns give the respective distance in millimeters that the optical centers must be removed from the visual axis to produce such an effect.

Some persons find it inconvenient to have two pairs of glasses when different lenses for distance and reading are required. In these cases bifocal lenses may be used, the reading portion being below and distance above. What are known as split bifocals are not usually satisfactory. The cement, or perfection bifocal, in which the reading lens is oval in shape, will be found preferable, but some persons can never become accustomed to them, as in looking downward the vision is so blurred that it produces an excessive amount of inconvenience.

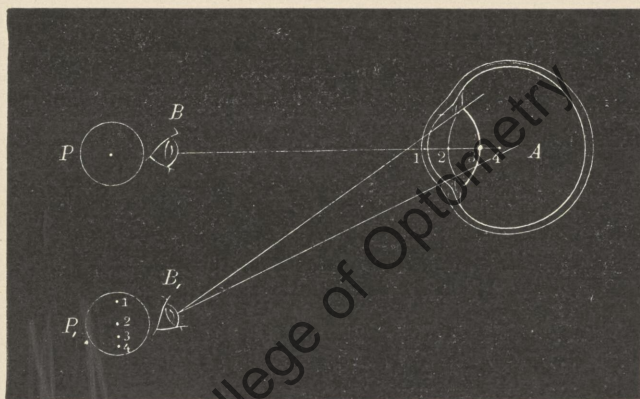


FIG. 126.—Parallax Movement for Determining the Location of an Opacity.

In cases where opacities exist in the refractive media good visual results are not always obtained, and the location of the opacities can be determined by the following method.



Parallactic movement for determining the position of opacities in the media. In the observed eye A are four opacities: (1) In the cornea; (2) in the anterior capsule; (3) in the posterior capsule; and (4) in the anterior portion of the vitreous. As they are located in a direct line, the observer at B sees but one point at the center of the pupil P. If the examiner moves to B. the relative position of the points changes and assumes the appearance seen in P.

In keeping records of cases, or in writing prescriptions for glasses, certain rules should be observed. Manufacturing opticians generally furnish their patrons with blanks designating lenses and measurements for frames. Abbreviations and signs are used. V. vision; O. D. or R. E. right eye, O. S. or L. E. left eye. Sph. for Spherical lenses, although this is usually understood. Cyl. for Cylinder, Cylindrical lens. Ax., for axis. O. U., both eyes.  $\bigcirc$  Combined with, used in writing for compound lenses, or lenses combined with prisms. P. D. or P. W., Pupillary distance, the distance from center of pupil to center of pupil. This should be measured by taking the temporal margin of the pupil of one eye and the nasal margin of the fellow eye.

The method for records that I have found most convenient, is similar to the card index system, keeping each individual record separate, and also each eye by itself. The general plan is as follows.

In keeping records a great deal of time is saved by the use of abbreviations, and the following will give an idea of how this may be done.

H. H——, æt. 25.

Student.

St. No.      Residence,

HISTORY.—Eyes ache on close use, objects fade. Frontal headache after use of the eyes for near work. Eyes feel sore and ache.

Ophthalmosc. ex. +1.00. O. U.

O. D. 20-20 -2 ; 20-20 w. +O. 75 D. 20-20 O. U. V.

O. S. 20-20 -1 ; 20-20 w. +O. 75 D.

J. No. 1  $\left. \begin{array}{l} 6\frac{3}{4}' \\ 6' \end{array} \right\} 4' - 24' \text{ O. U. w. above R.}$ 

Advised atropine.

20-60 -1 ; 20-20 w. +1.00 D.

V. w. atropine.      20-20 O. U.

20-80 -1 ; 20-20 w. +1.10 D.



## CHAPTER XXI.

### MICRO-ORGANISMS.

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Whether microscopic forms of life are the cause or the result of disease is a question which time only will determine. In healthy subjects, where no lesions of the eye are present, microscopic forms of life are found in abundance, even some of the supposedly virulent types. In morbid conditions of the eye there will be found an increase in the number, not only of the ordinary forms, but also some which are found only when morbid changes are present. For complete descriptions of micro-organisms the reader is referred to any work on bacteriology, as no description of the various forms will be given.

*Bacillus Cœrulefaciens*. This form has been met with but once in trachoma.

*Capsule Bacillus* of Loeb. This has been found in a case of keratomalacia infantum.

*Bacillus* of Colomiatti has been found in xerotic masses in the eye of a child, as well as in some cases of conjunctivitis.

*Bacillus Circumscriptus*. This form of life seems to be ephemeral, and its influence is undetermined.

*Bacillus Coli Communis*. This is found in many inflammatory conditions and is sometimes associated with other forms. In traumatic panophthalmitis it has been reported by Randolph.

*Bacillus Diphtheriæ* (Klebs-Löffler). In diphtheritic cases, especially of the nasal passages, and in pseudo-mem-

branous inflammation of the conjunctiva, this bacillus is usually present in considerable numbers.

Bacillus of Fick. There seems to be but little difference between this form and the bacillus lanceolatus pneumoniæ.

Bacillus Fluorescens Liquefaciens. This bacillus was found only once in eighty-four cases by Fick.

Bacillus Hirstitus. This has been found in the normal conjunctival secretion, and efforts to produce morbid changes by inoculation have proven futile.

Bacillus Influenzæ. This microbe has not yet been proven to exist in the conjunctival and lachrymal secretions.

Diplococcus Lanceolatus Pneumoniz. This form was first found by Pasteur and Bernberg in 1880 in saliva. It is supposed to be a causative factor in croupous pneumonia, as well as other inflammatory exudative diseases.

Bacillus Lepzæ. This is found only where the conjunctiva is affected.

Bacillus Mallei. This is the bacillus of glanders, and is seldom found in the human subject, but when the conjunctiva is affected it probably is the result of extension from the nasal tissues.

Bacillus Megatherium. This has been found once in trachoma and once on the normal conjunctiva.

Bacillus Mesentericus Vulgatus. This is quite common, being found in large numbers in the atmosphere, and probably is of value rather than detrimental.

Bacillus Mesentericus Ruber. This form also appears to be a normal denizen of the atmosphere.

Bacillus of Measles. Whether this form has any influence in producing morbid conditions of the eye is questionable.

Bacillus Mycoides. In one case of lachrymal obstruction only has it been found.

Bacillus of Pink Eye. Pure cultures of this supposed factor of disease have not been obtained.

Bacillus Prodigiosus. This seems to be one of the generally distributed forms, especially on substances containing



starch. It does not possess any influence in itself, so far as known.

*Bacillus Pneumoniæ* has been found in the secretions from the nose, and as occurring in the lachrymal tract and upon the conjunctiva. When found it is probably an accidental condition.

*Bacillus Pyocyaneus*. This is one of the most frequent forms of supposed pus-producing germs, and has been found in purulent conjunctivitis.

*Bacillus Septicus Keratomalaciæ*. Babes found this in broken-down corneal tissue, and different organs of a child who died from septicemia following keratomalacia.

*Bacillus Subtilis*. This form seems to be present everywhere and has no morbid characteristics.

*Bacillus Sucinacius* has been found once in a case of trachoma.

*Bacillus Syphilis*. It is a question whether a specific organism in this disease is ever present. Lustgarten has described a form found in some cases of syphilitic ulceration and discharge.

*Bacillus Tuberculosis*. In a few cases of lupus of the conjunctiva, and tuberculosis of the lachrymal apparatus this has been found.

*Bacillus Varicosus Conjunctivæ*. This has been described as occurring in healthy conjunctival secretion.

*Bacillus Violaceus Flavus* has also been found in a case of trachoma.

*Cladothrix Dichomata*. This form may occur in the lachrymal canal, forming chalky masses, which may attain considerable size and obstruct the passage of the tears.

*Micrococcus Canicinus*. This has been found more frequently in normal eyes than abnormal, and does not appear to have any morbid influence.

*Diplococcus Gonorrhæa*, *Gonococcus* of Neisser. This is found in purulent conjunctivitis, but does not seem to be present in all cases.

*Micrococcus Tetragenus*. This is a common form in the saliva, both normal and abnormal, and has been found in the secretions of the eye.

*Sarcina Alba*. This has been found in trachomatous subjects.

*Staphylococcus Pyogenes Aureus*. This form has been found in catarrhal conjunctivitis, as well as on the normal membranes.

*Streptococcus Pyogenes*. This seems to be associated with the Klebs Löffler bacillus, and in facial erysipelas when the eye is affected.

Up to the present, no definite form of microscopic life has been found which can be ascribed positively as a cause for trachoma, although many efforts have been made.

As to the influence of these micro-organisms on the eye, it is a question that will require the utmost care to decide. The advocates of both sides being equally positive in their assertions. The probability is that it will be shown that these microscopic forms of life have more the action of scavengers, and that their presence instead of being detrimental, is beneficial. The presence of large numbers of these micro-organisms in the purulent types of conjunctival or corneal lesions, can hardly be said to be the causative factors of the destruction of tissue. Their number may not be sufficient to destroy the morbid tissue and secretion, and the suppurative tendency will continue. The influence of these organisms, whether beneficial or not, is a question which the future must decide.



## CHAPTER XXII.

### OPERATIONS.

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Operative procedures on the eye and surrounding tissues require the most absolute cleanliness, both on the part of the operator and patient. By cleanliness is understood what is usually termed, "antiseptic precautions." In major operations, the patient should be placed in the best possible condition, both mentally and physically, and as a rule the evening before the operation, a cathartic should be given, thoroughly evacuating the bowels. The morning of the operation the patient should have a thorough bath, and the surfaces about the eye should receive especial attention, and the conjunctival surfaces thoroughly irrigated with a solution of boric acid.

Mild solutions only should be used, especially for flushing the culs-de-sac, as the stronger antiseptics will produce congestion and irritation of the mucous and corneal surfaces.

For corneal sections it is important to have the lachrymal passages and nares in as nearly a normal condition as possible. If there is a marked purulent discharge from the lachrymal sac, corneal incisions should not be made if possible to delay, until this condition has been relieved. If an operation is unavoidable under these circumstances, the sac should be thoroughly flushed with a solution of boric acid or pyoctanin (blue). Haab recommends the closing of the punctum by the use of a galvano-cautery needle where delay is impossible. The skin of the eyelids and face should be thoroughly washed with a good soap, and water to which borax has been added.

The use of a solution of bichloride of mercury in many of these cases is followed by more or less opacity of the corneal tissues, and it is questionable whether the weak solutions employed are of any value. The normal salt solution is frequently used, making the solution of boiled or sterilized water.

The hands of the operator should be scrupulously clean, which of course includes the nails.

**INSTRUMENTS.**—Instruments should be clean, and cutting instruments should have the highest possible polish. For the heavier instruments, soap and hot water are sufficient. For cutting instruments such as cataract knives, cystotomes, etc., care must be exercised in cleaning them so that the cutting edges are not injured. The use of carbolic

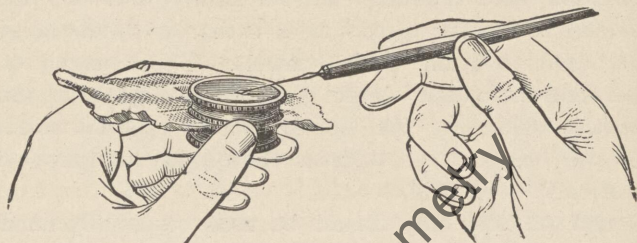


FIG. 127.—Test Drum.

acid and other preparations of this character will almost invariably injure the edges of the instruments. The use of a magnifying lens should not be neglected for examining the cystotome and toothed forceps. Recently the use of formaldehyde vapor for disinfecting instruments has been highly recommended. The keenness of cutting instruments should always be tested by means of the test drum. If the instrument penetrates the membrane of the drum with a crackling noise, the instrument should not be used, but if it penetrates readily and without noise, the edge is all that can be desired.



**DRESSINGS.**—All dressings used about the eyes should be antiseptic. An iodoform dressing is often used, but in many cases a poisonous effect is produced, and a number of surgeons have abandoned its use in operations about the eye. Borated gauze has proven satisfactory in the majority of cases. The method of applying dressings to the eye will depend upon the character of the operation.

**SUTURES.**—Either cat-gut or silk are most generally employed, and when the latter, the iron-dyed is used on account of being more readily seen, especially when the conjunctiva has been sutured. A suitable sterilizer will facilitate the preparation of instruments and dressings.

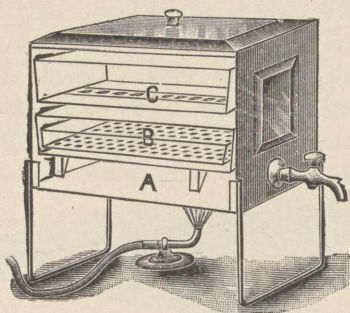


FIG. 128.—Sterilizer.

**ANESTHESIA.**—General anesthesia is necessary in enucleation, blepharoplastic operations, and often in glaucoma and advancement of the ocular muscles. In children and very nervous persons general anesthesia may be required in other operations, but as a rule it is not necessary.

**LOCAL ANESTHESIA.**—A solution of cocaine of from two to four per cent. is most generally employed. The best method is to make the solution fresh at the time of the operation, as fungoid growths soon develop when the solution is allowed to stand. After the instillation the eyelids should be closed on account of the action of the drug on the corneal epithelium. It is very seldom that more than three instilla-

tions are required of a four per cent. solution, the interval between instillations being five minutes.

There are a number of other drugs which have been recommended for local anesthesia instead of cocaine, but the advantages which they possess are not sufficient for a description here.

### OPERATIONS ON THE EYELIDS.

REMOVAL OF THE CILIA.—Two methods are employed.

Epilation by the use of forceps for removing the eyelashes. In this method care should be exercised not to grasp more than one lash at a time, and the traction should be steady, so that the lash is not broken off close to the edge of the lid. The fine white lashes, which are a frequent source of discomfort, can be seen by the aid of a magnifying glass. Where but few lashes are to be removed this method is generally employed, but as they usually grow again it is often necessary to resort to some other method.

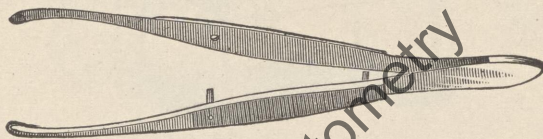


FIG. 129.—Cilia Forceps.

ELECTROLYSIS.—In this method a mild galvanic current is used, the electrolytic needle being placed in a convenient handle. The needle should be connected with the negative pole of the battery, and should be inserted along the lash to its root; the positive electrode, having a sponge fastened to it, is moistened and may be held by the patient, pressing the sponge in the palm of the hand, or the sponge may be pressed against the temple. When the circuit is closed, a whitish froth will be seen around the needle; a few seconds is all that is required for destroying the cilia bulb.

After withdrawing the needle, the lash should be grasped with the forceps and extracted. If any resistance is offered



it shows that the root is not destroyed and the needle should be reinserted. This method of removing the lashes is painful, so it is better to remove but a few at a sitting, repeating again in a few days until all are destroyed.

**ABSCCESS OF THE LID.**—An abscess of the lid is usually opened through the skin, making a transverse incision; the after treatment is that applied in general surgery.

**HORDEOLUM.**—A slight incision should be made deep enough to reach the contents of the sack, which then can be expressed by pressure.

**CHALAZION.**—In the majority of cases they should be removed by a conjunctival incision. In some few cases the incision may have to be made through the skin, when the incision should be parallel with the edge of the lid.

As a rule, it will be better to give the patient sufficient general anesthesia to make them tractable, but it is not necessary to produce full anesthesia.

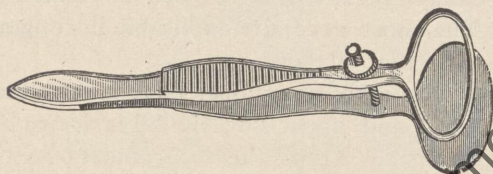


FIG. 130.—Demarre's Clamp.

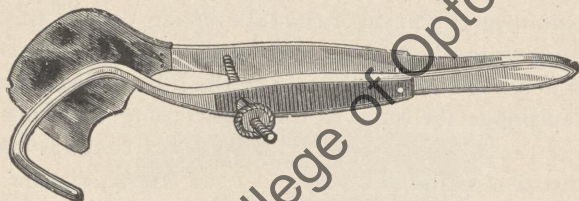


FIG. 131.—Snellen's Right and Left Clamp.



FIG. 132.—Small Scalpel.

The use of a lid clamp will be found convenient, and the operation then is practically bloodless. Another advantage in the use of the clamp is that it pushes the tumor forward,

the back of the clamp being solid, and the lid is also firmly held. If the incision is made on the conjunctival surface, the incision may be either linear or crucial, depending upon the size of the tumor. A small scalpel or Graefe knife may be used. After the sack is emptied a curette should be employed to break down the walls. The cavity will fill with blood, which is gradually absorbed.

CHALKY DEPOSITS IN THE MEIBOMIAN GLANDS.—May be removed by everting the lid and making a slight incision over the mass with a slender knife or eye needle, when the deposit may be lifted out.

Polypoid granulations of the conjunctiva, or warty excrescences at the margin of the lid, may be removed with a curved scissors, drawing the growth away so as to get as much of the base as possible. The application of an ointment of salicylic acid will generally be all that is necessary.

PTOSIS.—Many operations have been advocated for this condition. The most generally applicable in congenital or acquired ptosis is that of Panas.

In this operation a horn or rubber plate is introduced between the eyeball and upper lid; the lid is drawn over the plate, and an assistant keeps the integument over the eyebrow tense. An incision following the furrow between the tarsus and orbital portion of the lid is made, carried through the skin and muscle to the tarso-orbital fascia. A second incision is made near the margin of the lid, carried from the inner canthus to the outer canthus, excepting at about the middle of the lid, from eight to ten mm. of tissue is left intact. From near the extremities of the upper incision, two vertical incisions are made connecting the two horizontal incisions. An incision is also made just above the eyebrow and down to the periosteum, and it should be slightly longer than the upper incision in the lid.

The flap in the lid having been dissected loose, and also the tissues from the eyebrow down to the superior incision having been freed from their attachments, the flap is carried



up under the dissected tissue and fastened to the margin of the incision above the eyebrow. The lateral sutures are introduced as shown in the cut, and are for the purpose of preventing ectropion, which might result if they were not

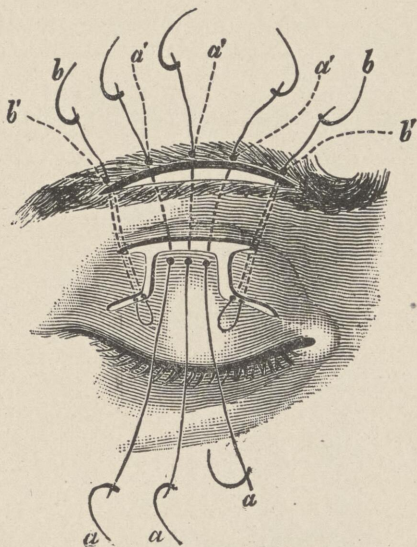


FIG. 133.—Panas' Operation for Ptosis

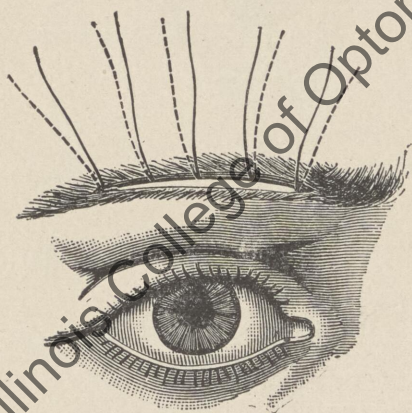


FIG. 134.—Operation Completed.

used. The wound should be dressed and bandages applied, and the sutures allowed to remain from four to seven days, depending upon the rapidity of healing.

**TARSORRHAPHY.**—The object of this procedure is to shorten the palpebral fissure. In order to obtain the proper amount of shortening the lines for the incision should be mapped on the skin with ink or an aniline pencil, determining the exact amount of space to be obliterated.

A spatula or shield is introduced between the eyeball and lids, and a flap from the free margin of each lid, deep enough to include the hair follicles, should be made near the external canthus. The edges are approximated by fine silk sutures. The sutures should be drawn just tightly enough not to cause a folding of the tissue. Three or four days is usually as long as it is necessary for the sutures to remain.

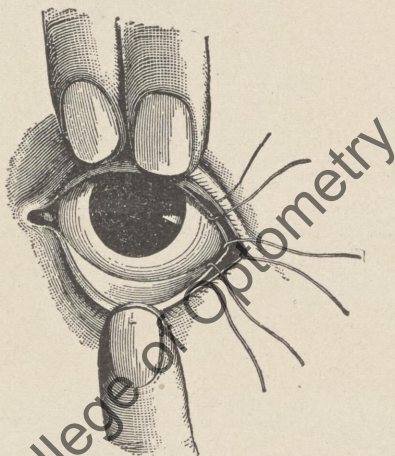


FIG. 135.—Canthoplasty.

**CANTHOPLASTY (Canthotomy).**—This procedure is for increasing a short palpebral fissure, and is performed only on the external canthus. The operation is divided into temporary and permanent.

When the enlargement of the palpebral fissure is simply



required to relieve the pressure exerted by swelling of the lids, as in purulent conjunctivitis, and the probabilities are that only a temporary enlargement is necessary, the incision through the commissure is made with a strong scissors, extending the line directly outwards. This will close of itself in a short time and is termed canthotomy.

In permanent canthotomy or canthoplasty the surfaces must be kept from uniting. After the incision has been made the conjunctiva should be freed from the underlying tissue, especially at the extremity of the incision, and sutures are passed through the tissues, one at the extremity of the incision, uniting the conjunctiva and skin at this point, and one each introduced near the inner ends of the incision, one in each lid. These, when drawn together, will cover the traumatic surface with the integument and conjunctiva, preventing their uniting and closing the wound.

EPICANTHUS.—The operation for this may be an elliptical incision over the root of the nose, approximating the integument after loosening it from the underlying tissues, approximating the edges with silk sutures, and covering the surface with protective adhesive strips, so that no interference with primary union can be made.



FIG. 136.—Lines of Incision for Epicanthus.—*Hansell and Bell.*

TRICHIASIS.—When but a few lashes are at fault, they may be removed with a cilia forceps or by electrolysis. When a considerable number of the lashes are involved or a complete distichiasis is present, a different method must be employed, and the Jaesche-Arlt operation is most generally employed.

This operation is performed by using a lid clamp, or steadying the lid with a shield which is introduced between the eyeball and lid. The edge of the lid is split by an incision in which the anterior portion contains the bulbs of the lashes, and is carried the full length, or as far as necessary to replace the faulty cilia. A second incision is made 5 mm. from the lid margin and is carried from near the inner to the outer canthus. Another incision is then made which extends in an upward curve from one end of the second incision to the other, and the integument between these incisions

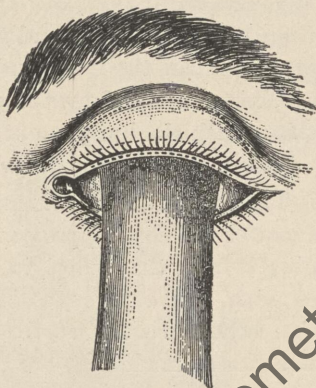


FIG. 137.—Jaesche-Arlt Operation for Trichiasis.—*Norton.*

The dotted line at the margin of the lid shows the intermarginal incision. The crescentic dotted lines on the lid show the second and third incisions.

dissected away. The edges of this area are approximated with fine sutures which draws the anterior marginal portion of the lid containing the hair follicles away from the cornea. In this procedure the fibers of the orbicularis muscle should not be injured. The lid should be dressed as in any surgical procedure, and as a rule the stitches can be removed by the end of the third day.

Other methods for operating for this condition are used, but this is most generally applicable of any. In this opera-



tion a small scalpel, curved scissors, mouse-toothed forceps, needles, needle holder and silk, and the lid champ or lid spatula are required.

**ENTROPION.**—Various methods have been employed for this condition. In spastic entropion of old people, the use of the cross-bar entropion forceps, grasping enough tissue to draw the lashes away from the eyeball and excising the tissue with curved scissors, closing the wound with silk sutures, and dressing as for any surgical operation, the sutures being removed the third day.

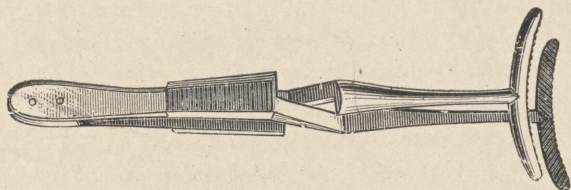


FIG. 138.—Cross-bar Entropion Forceps.

Von Graefe's method differs by excising a triangular portion of the tissue, the base of the triangle being 3 mm. from the ciliary region. The width and length of the triangle being governed according to the laxity of the tissue. After the incision of the triangular portion the margins are loosened and approximated with sutures, with the exception of the horizontal portion. This operation is especially applicable to the lower lid.

**GAILLARD-ARLT OPERATION.**—In this a suture with a needle at each end is introduced at the junction of the middle and inner third of the lower lid, the puncture being close to the border of the lid and the point of exit about as far beneath as the breadth of the thumb. The second needle is passed in a similar manner near the first, having the loop of the thread near the border of the lid. The second thread running beneath the skin parallel to the first.

A similar procedure at the junction of the middle and outer thirds of the lid is made and the ends of each thread

tied over a small roll of adhesive plaster and tightly drawn, causing a horizontal fold of skin on the lid, drawing the edges of the lid away from the eyeball. The threads should not be removed until suppuration commences, when cicatricial bands will have formed continuing the effect of the threads. This operation like many others on the lids may not be permanent, and no positive prognosis should ever be given in these operations.

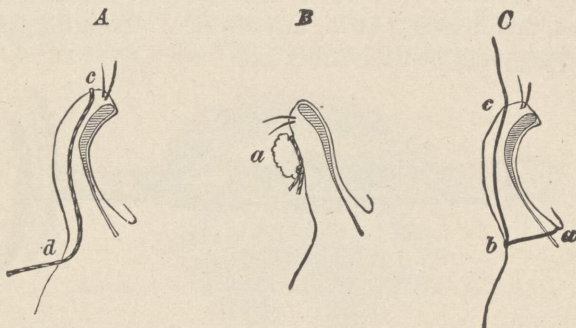


FIG. 139.—Methods of Operating for Entropion. Magnified 2x1.—*Fuchs*.

*A*, suture in Gaillard-Arlt Method; mode of applying the loop of thread. *B*, the loop drawn tight. *C*, suture in the Snellen method.

An operation for entropion which has given the best satisfaction, especially after cicatricial contraction in trachoma has occurred, is a modification of the Burow-Savage operation. In this operation the upper lid having been everted, an incision is made at the temporal portion, large enough to admit of the introduction of a fine grooved director, which is pushed to the opposite side of the lid, between the skin and conjunctiva, keeping the director beneath the cicatricial tissue. This tissue is divided its entire length, preferably with a sharp scalpel, then making four vertical cuts from the incision to the margin of the lid, carrying the incision deeply enough to sever all structures to the skin.



In cases in which entropion is excessive, a second incision should be made parallel with the first about 2-3 of the distance from the margin to the upper border of the tarsus, the incision being carried through the tissue in a manner similar to that of the first. By drawing the everted lid forcibly backward over the thumb or finger, considerable separation of the tissues will be made. No sutures are necessary, the traumatism healing by granulation. The lashes may be fastened to the lid by means of adhesive plaster, or a few fibers of cotton held in position by flexible collodion, which will also tend to further evert the edge of the lid. By the use of the second horizontal incision I have not found it necessary to use stitches in this operation.

ECTROPION.—Various operations for this condition are employed. When the ectropion is associated with considerable relaxation of the tissues, as frequently seen in old people, a V-shaped incision, including all the tissue of the lid, may be made; the parts are drawn together by two sutures. Ectropion, when the result of contraction of the tissues from injuries or abscesses, may require a plastic operation. When not too extensive the Wharton-Jones operation is usually employed. The lid spatula being placed between the lid and eyeball, a V-shaped incision is made, the flap is separated enough to allow the lid to be returned to its normal position, and the lower part of the incision is closed with sutures which converts the V-shaped incision into a Y. The triangular flap should include the cicatrix.

If the cicatricial tissue is extensive it may have to be dissected out, filling the gap by transplanting skin from the forehead, nose, or cheek. Where the lower lid has been extensively destroyed, restoration may be effected by the Dieffenbach method. This can be readily understood by reference to the figures.

In all plastic operations about the lids, care must be exercised that the transplanted portion is larger than the amount of space to be covered, as there is always contraction of the

flap, and if the size originally is only sufficient to cover the traumatic surface the stitches will cut through and the operation will prove a failure. Too much must not be expected in these operations, as it is impossible to avoid more or less scarring. Each case must be treated according to its merits. Careful bandaging and protection of the tissues must be observed.

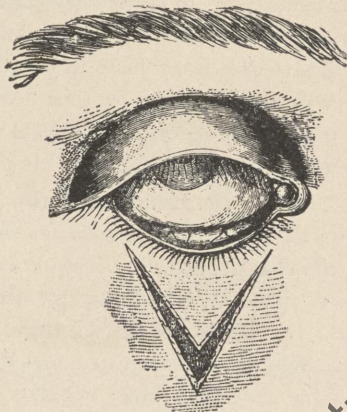


FIG. 140.—Wharton-Jones Incision.—*Norton.*

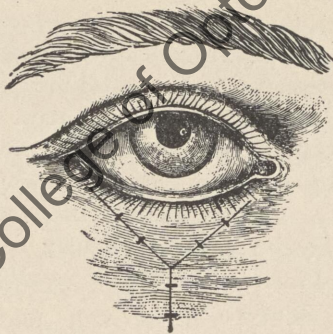


FIG. 141.—The Operation Completed.—*Norton.*



COLOBOMA OF THE LIDS.—Either congenital or traumatic coloboma, when not too extensive, can be remedied by freshening the edges of the fissure and carefully approximating the tissues. If there has been extensive ulceration some other method will have to be employed, and it will partake of the nature of a plastic operation.

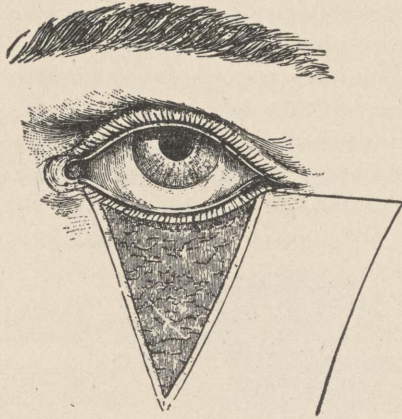


FIG. 142.—Dieffenbach's Operation.—*Norton.*

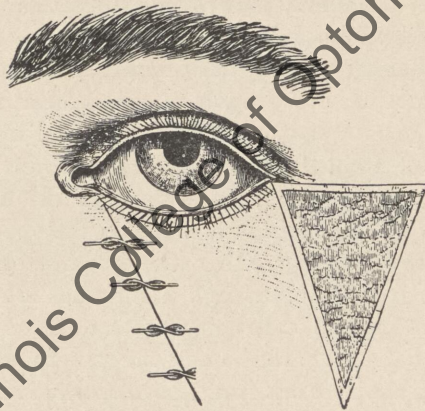


FIG. 143.—Operation Completed.—*Norton.*

## OPERATIONS ON THE CONJUNCTIVA.

Traumatic lesions of the conjunctiva on account of the vascular structure of this membrane usually heal rapidly. If the edges of the traumatism are very irregular they may be trimmed, and loosening the conjunctiva from the eyeball the wound can be closed by sutures. The surfaces should be thoroughly cleansed before this is done.

Foreign bodies are sometimes difficult of removal, especially when they have pierced the conjunctiva. The subconjunctival hemorrhage, which follows attempts to remove bodies, will in many cases obscure the object, especially in cases where grains of powder are embedded in the conjunctival tissue. When possible the foreign body should be seized with a fine forceps and removed by cutting the enclosed conjunctiva, using a pair of scissors curved on the flat. Powder grains may be burned out by the use of the galvano-cautery current, as suggested by E. Jackson.

PTERYGIUM.—A number of methods are employed for the removal of pterygium, but the one that has been the most satisfactory in my hands is the Prince operation.

In this operation blunt-pointed scissors, mouse-toothed forceps, eye speculum, and strong strabismus hook, or Prince's divulsion hook, needle-holder, needles and silk are required. After the eye has been rendered thoroughly anesthetic with cocaine, the growth is seized near the corneal margin with the forceps, a cut is then made with the scissors, extending from the corneal margin to near the base of the growth, carrying the incision through the healthy conjunctiva. A similar incision is made on the opposite side of the growth, then passing either the hook or blunt scissors between the growth and eyeball, the tissues are thoroughly loosened from the ball, care being taken to leave none of the morbid material. Then the base of the growth should be excised, making the first cut from above downward and inward to the center of the growth; a corresponding cut should be



made from the lower surface, meeting the first incision near the canthus. This will give a triangular incision at the base, with the apex at the canthus. Still holding the growth with the forceps, the hook should be passed to the corneal margin and the head of the pterygium torn loose from the cornea, giving a rotating motion to the hook. The edges of the conjunctiva should then be drawn as close together as possible, using two or three sutures. If the growth was pretty wide it will be better to make two incisions in the conjunctiva about 2 mm. from the cornea, one extending upward, the other downward, so that there will be no fold of the conjunctiva over the cornea. If this precaution is not taken the growth is liable to return. The stitches should be allowed to remain about three days. A wash of boric acid is all that is necessary, as a rule, for keeping the eye clean.

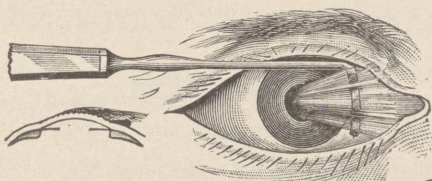


FIG. 144.—Separation of the Head of the Pterygium from the Cornea with Prince's Hook.

After this operation there will frequently be a small nipple of tissue form near the canthus, which is readily removed with a single snip of the scissors.

**SYMBLEPHARON.**—The treatment of this condition is sometimes very difficult. When the adhesions are not extensive, the band of tissue may be divided and an incision made in the conjunctiva of the eyeball and drawn over, suturing so as to bring a healthy surface in contact with the raw surface on the lid. In some few instances a suture of silver wire has been placed near the retrotarsal fold, and by gradually twisting the wire it will cut its way out. This method is not applicable except in rare cases, where the adhesion is near either canthus. The transplanting of skin

taken from the lower lid, being careful to leave an attachment at one end, has been suggested by Harlan. Transplantation of rabbit's conjunctiva has also been tried, and in some instances has given fairly good results.

**ANKYIOBLEPHARON.**—When the adhesions are of the edges of the lid only, it usually can be removed by passing a grooved director back of the lids and dividing the bands of tissue. If this condition is complicated by symblepharon the methods already given may be tried, but often nothing can be done.

**TRACHOMA.**—The expression method may be employed where the trachomatous mass presents the sago-grain appearance. If the surface of the lids is much infiltrated, the lid may be scarified preliminarily to expression. The patient should be put under the influence of a general anesthetic, as the operation is extremely painful. After the lid



FIG. 145.—Desmarre's Lid Scarifier.

is everted and scarified, if necessary, Knapp's roller forceps may be used, passing one roller between the eyeball and the everted lid, the other of course being on the everted surface. Firm, gentle pressure should be made on the forceps and the instrument drawn forward. The forceps are again



FIG. 146.—Knapp's Roller Forceps.

placed in position and drawn in different directions, so as to thoroughly crush and express the contents of the granulations. The pretarsal folds and the canthi must receive especial attention, for if any of the granulations escape they form a nidus for a return of the trouble. The thumb-nails of the operator may be employed in this operation instead of



the roller forceps, but where the lids fit closely over the eyeball it is difficult to reach the culs-de-sac and the extreme ends of the lids.

Following the operation of expression, the lids should be treated as though the operation had not been performed. It is the most satisfactory operation in trachoma, but it is not advisable to perform it in acute cases.

PERITOMY. OR SYNDECTOMY.—This operation is sometimes performed for relieving a dense pannus. It consists in the removal of a narrow strip of conjunctiva from around the cornea so as to divide the vessels which pass to the corneal tissue. The strip should be from 2 to 4 mm. wide. The operation is not uniformly successful, and is attended with danger to the cornea itself.

### OPERATIONS ON THE CORNEA.

Foreign bodies, particles of dust, steel, emery, etc., are often found adhering to, or embedded in the cornea. When they are superficial, they can usually be removed by using a wisp of cotton on a cotton carrier, or a sharpened match, or any similar means may be employed. When the foreign body is more deeply embedded in the cornea, the use of a spud or cataract needle may be necessary. If they are very



FIG. 147.—Spud and Needle—Pocket Style.

deeply embedded, so that there is danger of their falling into the anterior chamber in the attempt at removal, a small lance knife or broad needle should be passed into the anterior chamber, thus preventing the body from passing through in the effort at removal. When the foreign body is iron or steel it can usually be removed by the means of a magnet or electro-magnet, various forms of which are in the market.

*Treatment.*—Although in the majority of cases healing occurs without any after effect, in some instances an ulcer may form, or even an abscess of the cornea. After the removal of a foreign body, the eye should be carefully washed with some solution, preferably boric acid, and if there is much congestion of the eyeball one or two drops of a weak solution of atropine should be instilled. Gun powder grains may be removed from the cornea by electrolysis, as recommended when occurring in the conjunctiva.

**PARACENTESIS OF THE CORNEA.**—For performing this operation a speculum or lid elevator, fixation forceps, paracentesis needle or narrow knife, and a small spatula, are required. Cocaine anesthesia is usually sufficient, excepting in very nervous individuals or young children.

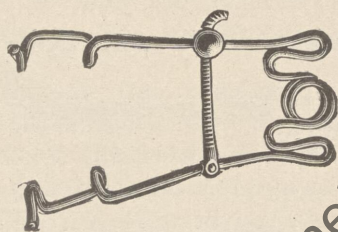


FIG. 148.—Stop Speculum.



FIG. 149.—Fixation Forceps with catch,—*Graefe's*.



FIG. 150.—Broad Paracentesis Needle.



FIG. 151.—Shell Spatula.

The puncture through the cornea is made near the lower margin unless an ulcer is present when the incision should be made through the base of the ulcer. The keratome-shaped knife is not as easily used as a narrow knife or broad



needle, requiring more pressure to make the incision. After the instrument has made its appearance in the anterior chamber it should be slowly withdrawn, rotating the handle sufficiently to enlarge the inner opening. If the needle is withdrawn rapidly it may be followed by a sudden gush of the aqueous, producing prolapse of the iris. The eyeball should be steadied by the fixation forceps, but undue pressure on the globe should be avoided. In introducing the needle it should be remembered that the point of the instrument should be nearly at right angles to the corneal surface, as otherwise it may pass between the corneal laminae and an entrance into the anterior chamber may not be effected. The operation may have to be repeated. The eye should be thoroughly cleansed after the operation, and either a mydriatic or myotic used, depending upon the point of incision and the character of the case. A bandage should be worn for two or three days.

COMPLICATIONS.—Prolapse of the iris may follow the operation. If possible to do so without exerting too much force, this should be replaced with a spatula, but when this cannot be done, it should be excised with a single snip of the scissors. If the prolapse is very small or the iris is simply resting against the incision and not protruding, it may be better to do nothing, as the anterior chamber filling, the iris will probably resume its natural position.

CURETTAGE.—A small curette or spud may be employed for this operation, which is used for indolent or spreading ulcers. After the eye has been rendered anesthetic with cocaine, the morbid tissue should be scraped from the ulcer. The treatment following is that ordinarily employed for ulceration of the cornea. Another method termed "hydraulic curetting" has been employed. A syringe with a fine tip is used, throwing a steady stream of water against the morbid tissue, which gradually washes it away. Different preparations may be used in this method, as a solution of

boric acid, normal salt solution, bichloride of mercury 1 to 2000.

**THE ACTUAL CAUTERY—GALVANO-CAUTERY.**—In some cases of corneal ulceration the employment of either of these two methods may be advisable. Cocaine anesthesia usually is all that is necessary. The platinum-tipped probe from the galvano-cautery, or platinum wire with a probe point may be used; it should be heated to a red heat in an alcohol lamp, or Bunsen burner, and the ulcerated area lightly touched. Care is necessary in this not to perforate the anterior chamber. It is desirable that healthy tissue is not touched with the probe in these cases. The amount of area implicated may be determined by using a drop of fluorescein solution which will stain the morbid tissue and not the healthy. In this operation the lids should be separated by the finger of the operator. After treatment is similar to that in curettage.

For removing deposits of lead in the corneal tissue, and the film in ribbon-shaped keratitis, the eyeball must be steadily held and the opacity scraped or shaved off. Only a small portion should be removed at the first sitting, as the healing process when completed will show how much improvement will follow the completed operation. Usually the results are favorable.

**SAEMISCH'S SECTION.**—For this operation, speculum fixation forceps, Graefe's knife, spatula, and a small syringe may be necessary. If the upper lid can be raised by the elevator in the hands of an assistant, a speculum may not be required. The conjunctiva below the cornea should be grasped with fixation forceps, seizing enough of the tissue to give a firm hold. The Graefe knife punctures the cornea at one side of the ulcer with the cutting edge forward. The knife is then pushed across the anterior chamber to the opposite side of the ulcer, when the counter-puncture is made and the knife cuts slowly but directly through the base of the ulcer. This will allow the escape of pus in the



layers of the cornea and at the bottom of the anterior chamber, but if the hypopyon is tenacious it may have to be washed out by means of a syringe, or it may be removed by the use of delicate forceps.



FIG. 152.—Graefe Knife.

Synechiaë are very liable to form after this operation, and if there is prolapse of the iris at the time it should be replaced if possible. The after treatment consists in the use of atropine and a bandage until healing has taken place. In some instances the wound may have to be re-opened with a probe or the knife used again.

Complications are synechiaë and leucoma. Panophthalmitis and total destruction of the cornea will probably result if the ulceration is not checked.

CONICAL CORNEA.—Various operations have been advocated for conical cornea. Von Graefe advocates the cutting off of the apex of the cornea, and applying solid stick nitrate of silver to the surface, the healing causing contraction and reduction of the cone.

Knapp uses a special galvano-cautery point, cauterizing the cone to Descemet's membrane, penetration of this membrane being avoided if possible. A second operation may have to be performed in some cases. After the healing is completed, an iridectomy may be performed, which will often improve vision. The scar which results from this procedure may be tattooed, which will lessen the unsightly appearance of the eye.

STAPHYLOMA.—Staphyloma which is partial may be reduced according to Berry, by passing a cataract needle through the base of the staphyloma, then excising an elliptical piece of the cicatricial tissue by means of a cataract knife, removing the part transfixed by the needle, and the needle itself, in the operation. In this case a firmly applied bandage should be worn for some time.

In complete staphyloma it is generally advisable, especially when the sclera is implicated, to perform an enucleation, or an eviscération.

**TATTOOING THE CORNEA.**—The instruments required are a tattooing needle and speculum. General anesthesia is to be employed in this operation. The object is for the cosmetic effect as a rule.



FIG. 153.—Tattooing Needle.

India ink rubbed with water until a paste is made, or according to Noyes, the India ink is allowed to soak for several hours until the consistency of a thick paste is obtained. The lids being separated, the eyeball may be steadied with the fingers and some of the ink dropped on the cornea. This should be pricked into the cornea by means of the tattooing needle, the position in which the needle is held being obliquely to the eyeball. This is continued, adding more ink, and pricking it in until the leucoma is no longer visible. A uniformly black color will result when the operation is successfully performed. After the operation the excessive pigment can be washed away with a solution of boric acid.

#### OPERATIONS ON THE SCLERA.

In wounds of the sclera, especially over the ciliary body, care must be exercised or more mischief may be done than the original lesion would cause. Small penetrating wounds, after a thorough cleansing of the eye, are best left alone. In the majority of cases the conjunctiva will cover the traumatism. If the edges of the wound however, are exposed it should be covered with conjunctiva.

Incised or lacerated wounds inclined to separate, or if a bead of vitreous protrudes, this should be excised with scissors, and fine sutures introduced through the outer



layers, care being taken not to injure the inner tunics. Extensive wounds of the sclera may require suturing of the scleral coat. This is an operation which requires the utmost care not to include the ciliary body and choroid in the wound. The after treatment consists in cleanliness and bandaging.

In these cases complications are very liable to occur, sympathetic ophthalmia, or detachment of the retina often resulting.

**SCLEROTOMY.—ANTERIOR SCLEROTOMY.**—This operation is sometimes performed in simple glaucoma where the anterior chamber is deep; in inflammatory glaucoma where the iris is atrophied, or when an iridectomy has failed to give relief. In this operation the fixation forceps, Graefe knife, and speculum are required. The knife is introduced in the sclera about 1 mm. from the cornea, passed through the anterior chamber, making the counter-puncture at a corresponding point on the opposite side, the cutting edge of the

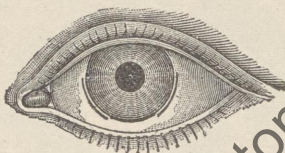


FIG. 154.—Anterior Sclerotomy with the incision below.—Noyes.

knife being upward. The incision is carried upward by a firm motion of the knife, by pushing the knife forward until the heel is close to the eyeball and then withdrawing, the section being completed if possible by the time the point of the knife is close to the edge of the counter-incision. A narrow bridge of scleral tissue should be left at the top of the incision connecting the cornea with the sclera. The knife should be carefully withdrawn in order to prevent prolapse of the iris if possible. If prolapse occurs a careful attempt at replacement should be made with the shell spatula, but if it is impossible to replace it, the prolapsed iris

should be excised. Eserine should be instilled into the eye prior to the operation as this will lessen the chances of prolapse.

**POSTERIOR SCLEROTOMY.**—This operation is performed in some cases of hemorrhagic glaucoma, preliminary to an iridectomy, or when the anterior chamber has been obliterated. Instruments used are the same as for anterior sclerotomy. The Graefe knife should be introduced 8 mm. from the corneal margin and between the external and inferior recti muscles, passing the blade to a depth 4 to 6 mm. towards the center of the globe. Withdrawing the knife slowly, a quarter turn may be made which will form a triangular wound. Before making the scleral incision in this operation the danger of infection may be lessened by making the conjunctival incision, then moving the knife a little to one side, so that the two openings do not coincide.

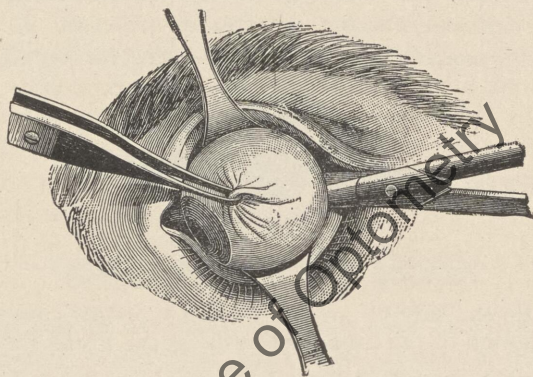


FIG. 155.—Enucleation.

**ENUCLEATION.**—The instruments required are fixation forceps, dissecting forceps, speculum, strabismus hook, and enucleation scissors, which are curved on the flat. The operation is generally performed under general anesthesia. The lids being separated with the speculum, the conjunctiva is seized with the fixation forceps near the cornea, and with



the scissors the conjunctiva is incised, the incision extended around the cornea as close to the corneal margin as possible. The tissues should be dissected back in all directions, and then with the strabismus hook the recti muscles caught and divided close to the ball. The external rectus may be divided a little back from the ball in order to leave a point to grasp with the fixation forceps. Drawing the eye forward, the scissors are introduced between the dissected tissues and the eyeball, following the curve of the latter, until the optic nerve is reached, when the blades are separated and the nerve divided a short distance back of the globe. The attachments of the globe and any tissues which may still be attached to it are severed, and the eyeball removed from the socket. Usually the scissors are introduced from the temporal side, but in some cases it may be easier to introduce them from the opposite side, the eyeball being strongly rotated in the opposite direction from which the scissors are introduced.

The hemorrhage is seldom excessive, and can be controlled by pressure. The orbit should be thoroughly flushed with a solution of boric acid and a dressing of dry boric acid dusted over the surface. The advisability of suturing the conjunctival wound is an open question, in some instances it may be done before the dressing is completed. A small roll of gauze, or cotton wrapped in gauze, may be inserted between the lids to facilitate drainage. A moderate compression bandage should then be applied, and the patient kept quiet in bed for several days. The dressings should be changed frequently enough to keep them clean, and the orbit flushed at each dressing with a warm boric acid solution.

COMPLICATIONS.—Occasionally secondary hemorrhage may occur. When this happens the dressings should be removed, the lids separated, and the blood clot washed out, irrigating the orbit thoroughly. It is seldom that water hot enough to control the hemorrhage can be employed,

but the orbit may be packed with gauze, so as to produce more pressure and the bandage re-applied.

Infiltration of the tissues of the orbit and lids may be considerable, but seldom is a serious complication, absorption gradually taking place.

**PERFORATION OF THE SCLERA.**—When the walls are thinned, the sclera may be punctured in endeavoring to sever the nerve, prolapse of the eye following, complicating the operation. In case any of the sclera is left in the orbit it must be found and removed.

Cellulitis, meningitis, tetanus, and acute mania sometimes follow an enucleation. In cellulitis or meningitis, deep incisions through the orbital tissues, extending to the posterior portion of the orbit should be made.

Insertion of an artificial eye had better be deferred for a month or six weeks after an enucleation, although some operators introduce an eye within a week or ten days. The tissues should be thoroughly healed before an attempt is made to wear the shell. The eye first worn should be somewhat smaller than the other eye, and worn only for a few



FIG. 156.—Front View of Shell.  
Measurements in mm.

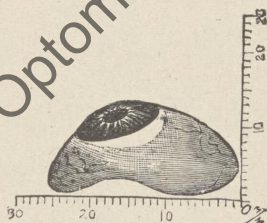


FIG. 157.—Side View of Shell.  
Measurements in mm.

hours at a time. The shell should never be allowed to remain in the socket over night. On removal of the eye from the socket it should always be washed with clean water. The secretions soon roughen an artificial eye, and after the



enamel has ceased to be smooth, the eye should not be worn.

To insert an artificial eye the edge of the upper lid should be drawn down and out, and the larger end of the eye inserted vertically beneath it. The eye will almost assume a horizontal position itself. The lower lid, when the shell is in a horizontal position should be pulled down, when the shell will slide into place. In removing the eye, if the end of the thumb is brought to the edge of the lower lid, and the lid drawn downward, rolling the eye upward at the same time, it will tip the lower edge forward and the pressure of the upper lid will be sufficient to force it out. Until the patient learns to handle the eye, it is better to remove it by bending over a pillow, or some soft substance, so that in case it drops it will not break.

EXENTERATION OR EVISCERATION.—This operation is not advisable excepting in rare cases. If there is any possibility of the affected eye causing sympathetic ophthalmia, the operation should never be performed. The instruments required are, narrow bladed knife, scissors, evisceration scoop, fixation forceps, speculum, needles and sutures. General anesthesia is necessary in these cases.

With the lids separated with a speculum, the conjunctiva is divided, the line of incision being close to the cornea as in an enucleation. The tissues should be dissected to the equator of the globe. If a narrow knife is used it is passed through the anterior chamber at the horizontal meridian, and the lower portion of the cornea is separated, then holding this portion with forceps, the upper portion is cut away at the sclero-corneal margin. If a Beer's knife is used the cut is usually made upward, pushing the knife to the heel, dividing all the tissues, then reversing the knife, the downward cut is made.

The contents of the globe are thoroughly evacuated with the evisceration scoop, or curette, removing all the softer tunics so that nothing but the scleral coat remains. The

cavity of the globe is cleansed with sterilized cotton or gauze, and the hemorrhage should be thoroughly controlled, otherwise the healing process will be delayed. Prince recommends cauterizing the scleral cavity with a 95 per cent. solution of carbolic acid. After the surface remains clear, and blood points no longer show, the edges of the sclera are approximated with cat-gut sutures and the conjunctiva is drawn together, using silk sutures for the purpose.

This operation gives a more movable stump for an artificial eye than is possible in an enucleation. The dressing and after treatment are similar to that of enucleation, but more time is required for healing.

*Complications.*—Secondary hemorrhage may occur, and infiltration of the surrounding tissues nearly always follows.

In order to allow drainage, it may be necessary to use silk, or horse-hair drainage until healing is established.

**MULES' OPERATION.**—In this operation a glass ball is introduced into the scleral cavity. It is important in this operation that the external ocular muscles are not disturbed. The evacuation of the globe should be carefully performed, so that a perfectly clear white sclera shows. All bleeding points must be controlled, this may be done by packing the scleral cavity with gauze. After the surface is properly prepared, a glass sphere of proper size is introduced into the scleral cavity. It should be one that can be easily fitted, and the operation may be made easier by splitting the sclera vertically for about 4 mm. at the upper and lower corneo-scleral margins. The sclera is then stitched vertically, and the conjunctiva horizontally, and the dressings are applied. The most scrupulous cleanliness must be observed throughout the operation and in the subsequent care of the eye.

The patient can be allowed to get out of bed after three or four days. Both eyes should be bandaged for at least forty-eight hours. An artificial eye can often be worn at the expiration of the second week. Reaction may be consider-



able following the operation, and should be controlled by the usual methods.

**RESECTION OF THE OPTIC NERVE.**—This operation is a substitute for enucleation, but has not been followed with as successful results as could be wished. It is not a preventive of sympathetic ophthalmia, and softening and atrophy of the globe have followed the operation.

The operation is performed by making an opening between the inferior and external recti muscles, then passing the scissors back, keeping them in contact with the globe, and dividing the tissues until the optic nerve is reached. The nerve is caught by means of a strabismus hook, as far back as possible, and the nerve divided. The eyeball should then be rotated to bring the nerve to the incision, which is then cut as close to the sclerotic as possible. The hemorrhage usually is considerable, and pressure should be made with the forceps before their removal, and the eye rotated to its original position. Protrusion of the eyeball is often considerable for a time, but ordinarily it will gradually recede. After treatment consists in cleanliness, and bandaging the eye until the healing process is complete.

*Complications.*—Abscess of the orbit or meningitis may result.

**EXTIRPATION OF THE CONTENTS OF THE ORBIT.**—This may be required in malignant diseases. After the removal of the eyeball, as in ordinary enucleation, an incision at the outer canthus is made, extending to the edge of the orbit. The lids being retracted, the tissues back of them and the periosteum within the orbital margin are divided. The periosteum is then separated to the apex of the orbital cavity. Detaching the entire mass with strong curved scissors. Hemorrhage is often excessive, but may be controlled by pressure, or the actual cautery may be required. The cavity should be packed with gauze and bandaged. In cases in which the eyeball is so much affected that the operation of

enucleation can not be performed the entire mass may have to be removed without attempting to enucleate.

*Complications.*—When the tissues have become so much involved that the entire orbital contents have to be removed, the operation is seldom successful as regards life. In some instances it has been, but the danger of cerebral complications is so great that relief is all that can be promised.

**OPERATIONS ON THE IRIS AND LENS.**—For operations on either of these structures, the general health of the patient should be as good as possible. In all of these operations the light should be bright and without strong shadows. The use of cocaine is all that is necessary in the majority of cases, the exceptions being children and nervous people.

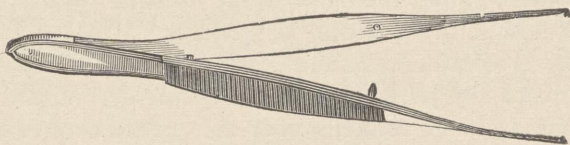


FIG. 158.—Straight Iris Forceps.

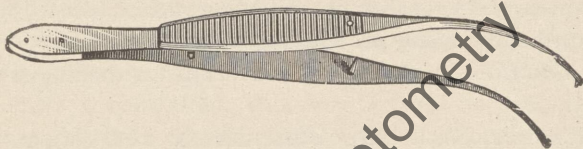


FIG. 159.—Curved Iris Forceps.

The instruments necessary are fixation forceps, speculum, lance-shaped knife or Graefe's knife, iris forceps, curved iris scissors, spatula, probe, and Tyrrell's blunt hook. The fixation forceps should have the teeth large enough to obtain a firm hold on the episcleral tissue. The speculum should not press against the eyeball, and should be of sufficient strength to prevent spasmodic closing of the lids.

**IRIDECTOMY.**—An iridectomy is made for one of two conditions. First, for an optical pupil; this operation is required when the natural pupillary space has become occluded by disease or malformation, also when there are opacities in



the cornea or lens in such a position as to interfere with the passage of light, and also is sometimes performed in conical cornea. A careful examination of the eye, with the pupil dilated, and by the use of the stenopæic disk of the trial case, should always be made before attempting an iridectomy

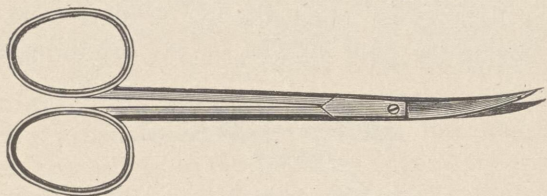


FIG. 160.—Curved Iris Scissors.



FIG. 161.—Tyrrell's Blunt Hook.

in order to find whether the artificial pupil will improve vision. The second object of an iridectomy is for the relief of inflammatory conditions of the eye; this may be called a curative pupil. It is performed in cases of chronic recurrent iritis, where broad or circular synechiæ interfere with the circulation of the aqueous from the posterior to the anterior chamber. Iris bombe is one of the strongest indications for this operation. In primary and consecutive glaucoma, for the relief of intra-ocular tension, and for the removal of tumors or foreign bodies, when located in the anterior portion of the eye, and their removal is impossible without removing a portion of the iris.

As a preliminary operation for cataract, or as one of the steps for ripening an immature cataract, and also for the removal of prolapse of the iris, whether following an injury or an operation. When the iris protrudes through a recent wound, if the lens is not injured and the laceration does not involve the ciliary region, the iris may be left alone. After extraction of cataract, prolapsed iris may swell and become cystic, as well as produce a high degree of astigmatism. Excision of the iris is ordinarily the best treatment in these

cases. If an iridectomy can be performed it is usually best to do so.

An ambidextrous operator will always stand or sit back of the head of the patient. The patient being in the recumbent position on the operating table or chair. If a good natural light is not obtainable, an artificial light may be used, having the light thrown on the eye through a large lens.

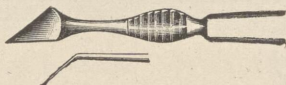


FIG. 162.—Angular Keratome.

The eyelids being separated with a speculum, the fixation forceps are made to grasp enough of the conjunctival and sub-conjunctival tissue to give a firm hold for steadying the globe. The forceps should be in such a position that the thumb is next the catch, in order to release the forceps when necessary. If the incision is made with a lance-shaped knife, or keratome, the point should be opposite the forceps at the upper part of the cornea, the point being at right angles to the cornea, and when it is seen entering the anterior chamber, which is easily recognized by the bright appearance of the free portion, the handle is depressed so that the blade is parallel with the iris, and the incision is enlarged as much as necessary for completing the operation. The blade should be slowly withdrawn, tilting the point towards the cornea, as it is important that the knife does not injure either the iris or lens capsule on the one side, or the posterior surface of the cornea on the other.

Injury of the capsule would be followed by cataract, and injury of the posterior surface of the cornea would leave a permanent streak. Steadiness of the hand is important. The tip of the knife should be flexible and sharp, as otherwise an undue amount of pressure will have to be exerted to force it through the cornea. In cases where the anterior chamber is shallow, the Graefe knife may be employed, the



puncture and counter-puncture being made as for cataract extraction, but the knife is introduced at a higher level. The knife should be directed towards the center of the pupil, and then carried across, making the counter-puncture, and cutting upward to increase the size of the internal incision. After the incision has been completed by either method, the fixation forceps may be entrusted to an assistant, and the scissors held in the right hand, the iris forceps in the left. The iris forceps closed, are introduced into the anterior chamber, and carried to the pupillary edge of the iris, opening the forceps, the iris is caught between the points and the forceps again closed, drawing the iris out at the incision, the amount depending upon the extent of iris to be excised. The iris is cut off close to the cornea, the blades of the scissors being parallel to the incision, or if a small iridectomy is wanted, at right angles to it. One snip of the scissors should be sufficient for an ordinary sized iridectomy, but where considerable tissue is to be excised, two or three may be required.

The iris forceps should be delicate, and when closed should remain closed, even when the arms of the instrument are pressed tightly together, otherwise the iris will be released. No rough or sharp edges should be present, as mischief may be done by their becoming entangled in the iris. Undue force must not be employed in withdrawing the iris as an iridodialysis may result.

*Adjustment of the Lips of the Incision.*—No foreign material should be left in the incision, especially iris tissue, as the healing will be retarded, and a result of entanglement of the iris at the angles of the incision may be an irritative condition, glaucoma, iridocyclitis, suppurative iritis, sympathetic ophthalmia, or perhaps a corneal fistula. The iris tissue can usually be removed from the angles of the incision by means of a shell spatula, releasing the iris from its entanglement. The edges of the incision may be closely approximated by passing the spatula over the traumatism, the

flat side being against the cornea and moving at right angles to the incision.

After the operation is completed, both eyes should be bandaged and the patient placed in bed. Usually there are no complications if the operation has been well performed. It is not often necessary to open the eye under three or four days, unless some complications arise.

*Complications.*—In some cases there will be considerable hemorrhage into the anterior chamber after the excision of the iris. This may be removed by the use of a shell spatula, carefully separating the lips of the incision and making a light pressure on the cornea. This must be carefully performed or the lens may be injured, cataract resulting. In several instances I have had good results by carefully flushing the eye with a warm solution of boric acid. When this complication occurs, special attention must be paid to the position of the iris before bandaging the eye, so that none of the iris tissue is left in the wound.

*Position of an Iridectomy.*—For an optical pupil the iridectomy should be small, the incision being made 2 mm. from the limbus and in the clear portion of the cornea, and usually is 3 or 4 mm. in length. In this form of iridectomy a Mathieu forceps should be used, or the blunt hook, excising simply the central portion and bringing the coloboma where it will give the best vision.

*Glaucoma.*—In glaucoma the iridectomy should be large and peripheral, the incision being at least 1 mm. behind the limbus. In acute glaucoma, when the tension is considerable, general anesthesia should be employed, as the effect of cocaine does not penetrate deeply enough to render the iris insensitve. If the iridectomy does not give the relief expected, a second operation may be performed, although sclerotomy is preferred by some in this condition. After the extraction of cataract, or a discission, glaucoma may occur, which is often relieved by the use of myotics, but if they fail an iridectomy should then be performed.



**IRIDOTOMY.**—This operation is sometimes performed after a cataract operation, where the pupil has become occluded or is considerably displaced through prolapse of the iris. The operation consists in dividing the iris from the pupillary margin to its periphery. For performing the operation, in addition to the knife, fixation forceps, and speculum, DeWecker's iridotomy scissors are usually employed, one blade of the scissors being in front of the iris, the other back, the iris being divided by a single cut. Two incisions may be made if necessary.

Another method of dividing the iris is by the use of a broad needle, dividing the iris fibers, or a small iridectomy may be made by the use of a blunt hook, drawing the iris through the incision. In the DeWecker method, in which the scissors are used, there is often some loss of vitreous.

Corelysis or division of anterior or posterior synechiæ has been performed in some cases, but the results have not been successful enough to warrant the operation, as a rule.

### OPERATIONS ON THE LENS.

The character of an operation for cataract depends upon the consistency of the lens substance.

**DISCISSION OR NEEDLE OPERATION.**—By this method the anterior capsule of the lens is ruptured, admitting the aqueous, and absorption of the lens cortex results. This method is used in young persons, and for soft, zonular, and partial cataracts, seldom being employed after the age of fifteen. The instruments required are cataract needles, or knife needles, speculum, and fixation forceps. Excepting in tractable subjects, general anesthesia is preferable.



FIG. 163.—Beer's Straight Cataract Needle.



FIG. 164.—Knapp's Knife Needle.

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After the lids have been separated by the speculum, the fixation forceps are applied to steady the eyeball. In many cases the weight of the forceps will be sufficient to hold the eyeball in position, and an assistant is not required. The needle used should penetrate the cornea near the outer margin, and be directed beyond the center of the pupil. Then turning the point of the needle to the lens, pressing a little inward and downward, the capsule is ruptured by giving the handle a lever-like motion, and the lens matter slightly disturbed. Care must be exercised or the lens may be dislocated into the vitreous, and at the first operation the lens matter should not be too freely disturbed, as the reaction may be severe through extensive swelling of the cortex, injuring the iris and ciliary body.

After absorption ceases, the operation may have to be repeated. This should not be done until the eye becomes perfectly quiet. In the first operation only one needle is usually required, but in the second operation the needle may be used more freely, or two needles are used, as shown in the figure. The points of the needles being introduced into the lens, the handles of the instruments are approximated, producing sep-

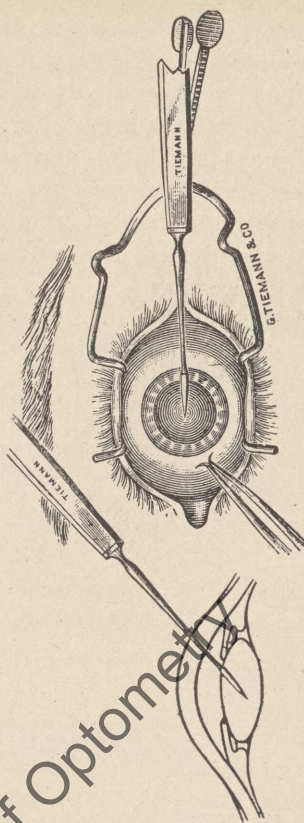


FIG. 165.—Single Needle Operation.—*Norton.*



aration of the opaque cortex. Two needles are preferable where there is not much lens matter remaining.

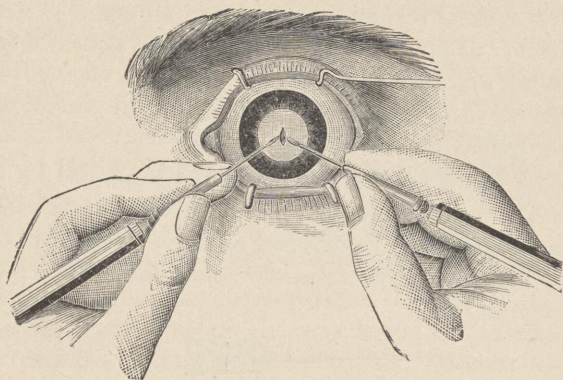


FIG. 166.—Double Needle Operation.—Noyes.

*After Treatment.*—The eye should be thoroughly flushed with boric acid solution, and a solution of atropine used to keep the pupil well dilated. The patient should be placed in bed, and remain there for twenty-four or forty-eight hours. Cold compresses or iced cloths may be employed for twenty-four hours, and the use of the atropine should be continued as long as there is hyperemia of the ciliary region. If the hyperemia is excessive and accompanied with pain, the atropine must be used oftener, and the bowels should be thoroughly evacuated. If the swelling of the lens cortex is considerable, a glaucomatous state may present, as well as iritis. In this condition, when the anterior chamber contains considerable swollen lens matter, it should be removed by a linear extraction or a paracentesis of the cornea. The suction method is often employed in these cases. The operation of discission is not as free from danger to the integrity of the eye as many suppose.

*Suction Method.*—This is used in soft or fluid cataracts, as well as for the removal of lens matter after a discission. The pupil being dilated, the anterior capsule is lacerated. A small corneal incision is made, which passes obliquely through

the cornea between the center and periphery. Through this incision the suction curette is passed. This consists of a curette with a handle and India rubber tubing, having a mouth piece at the end, the operator gently sucking the lens matter into the syringe. (Teale).

The after treatment consists of rest in the recumbent position, atropine and a bandage.

**LINEAR EXTRACTION.**—This method is employed for the removal of soft cataract where the nucleus is quite small, as well as after discission. According to Noyes the operation should be performed only in cases of soft cataract in persons under the age of thirty.



FIG. 167.—Knapp's Cystotome.



FIG. 168.—Daviel's Curette.

The instruments required are narrow keratome, or lance-shaped knife, cystotome, curette, speculum and fixation forceps. The pupil should be dilated before the operation. The keratome should be introduced about 1 mm. within the corneal margin, making an incision about 5 mm. wide. In withdrawing the instrument a lateral motion should be given to enlarge the inner portion of the section. The cystotome is then introduced and the lens capsule freely lacerated. By

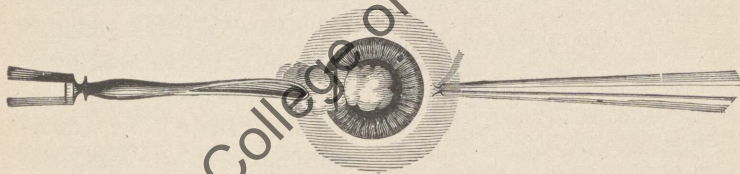


FIG. 169.—Linear Extraction.—Hansell and Bell.

depressing the posterior lip of the incision with a curette, the soft lens matter may be expelled by making counter-pressure on the cornea with a shell spatula. An iridectomy in some cases may be necessary, and can be performed after the cor-



neal section is completed and before rupturing the capsule. The after treatment is the same as in the forms already given.

**HARD CATARACT.**—Various methods of extracting hard cataract are in vogue, nearly every operator having a method peculiar to himself, but the general principles are very similar. The instruments required are speculum, Graefe or Knapp knife, or the triangular Beer knife, fixation forceps, cystotome, Daviel's spoon or curette, oval-tipped flexible probe, and wire loop.

Cocaine anesthesia is usually all that is required, excepting in very nervous persons. The eye is steadied with the fixation forceps as for an iridectomy, the lids being separated by the speculum. The cataract knife should be held in a manner similar to a pen, that is, between the thumb, index and middle finger. In uncomplicated cases the puncture or point where the knife enters the cornea should be in the transparent portion of the cornea close to the margin, and but a little above the horizontal meridian; the knife should be passed steadily through the anterior chamber and the counter-puncture, or point of emergence, at the opposite side, should be at a point corresponding to the puncture. On account of the refractive condition of the cornea, the tendency is to carry the knife closer to the sclero-corneal margin than it should be for the counter-puncture. The section is completed by pushing the knife to the heel, making a firm upward pressure, and then withdrawing to near the point, when it should be slightly turned to finish the section. The incision should be made parallel and close to the iris. When the section is nearly finished, the knife may be turned slightly, making a small conjunctival flap, or it may be cut directly through without forming a flap.



FIG. 170.—Knapp's Hollow Ground Cataract Knife.

Whether on completion of the section the fixation forceps and speculum are removed is a matter of individual preference. In tractable patients the removal of both of these instruments will relieve more or less pressure on the globe



FIG. 171.—Wire Loop.

and lessen the danger of prolapse of the vitreous, but it further complicates the following steps of the operation, as considerable must be trusted to the ready response of the patient to the commands of the operator.

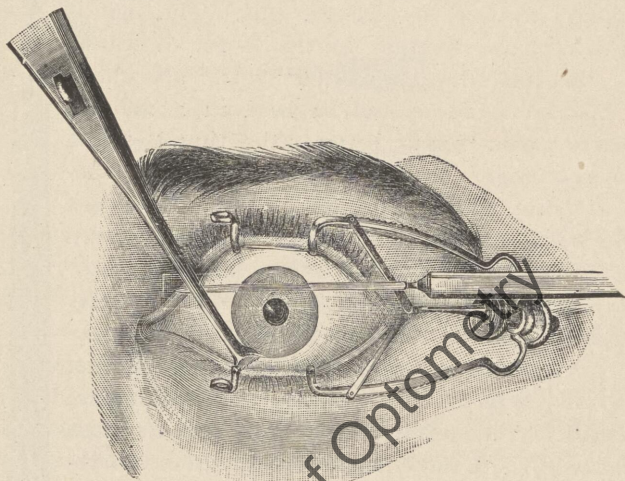


FIG. 172.—Method of Making the upward incision.—Noyes.

Some preliminary training of the patient will aid the operator. Just before the adjustment of the fixation forceps, but after the speculum has been placed, the patient should be directed to look up, down, right and left, repeating the commands until the motions are unhesitatingly and steadily obeyed. The patient must also be cautioned not to squeeze the lids tightly together when the speculum and forceps are removed. This procedure will aid materially in the various steps of the operation.



The capsule is opened by introducing the cystotome, having the back of the instrument towards the pupil. When the point has reached the pupillary space, it is pushed under the upper part of the iris and turned backward, so that the cutting point is against the capsule. It is then drawn across the capsule, making an incision concentrically with the corneal margin. (Knapp). The incision may be made similar in shape to an inverted V or an inverted T. The Knapp incision is somewhat difficult to make, and there is danger of displacing the lens or rupturing the suspensory ligament.

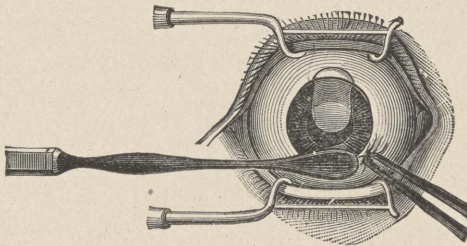


FIG. 173.—Passage of the Lens.—*Hansell and Bell.*

After the capsule has been thoroughly ruptured, the lens may be expelled, and different methods of coaxing the lens are used. The wire loop in one hand and David's spoon in the other may be used. The patient looking steadily down, the convex surface of the spoon is applied to the lower margin of the cornea, and gentle, steady pressure is made towards the center of the eyeball. This causes the corneal section to separate and the lens will gradually slip out. When the greatest diameter of the lens has escaped, the spoon is gradually passed upward, expelling the mass. In case the pupil does not dilate readily, the upper portion of the iris bulging, the pupil may be enlarged by pressure on the presenting portion of the iris, pushing it backward with the wire loop. Pressure may also be made on the lower portion of the cornea by means of the lower lid, steadying it against the eyeball with the finger and making counter-pressure back of the corneal incision with the lens spoon or scoop. This

manipulation requires considerable delicacy of touch, as any sudden motion may result in loss of vitreous.

The use of a solution of boric acid, or normal salt solution, may be used for flushing the eye during the operation. It will have a tendency to keep the eye moist, and also wash away any small particles of lens matter that may be present. Usually some particles of the cortex will remain after the nucleus and major portion of the lens have been removed. These may be coaxed out by a similar method to that employed in removing the lens, or by simply pressing the edge of the lower lid upward over the cornea by means of the finger. Cortex between the lips of the incision must be removed with a spatula, and if any particles are in the anterior chamber they may be coaxed out by gently stroking the corneal surface.

In case the iris does not resume its normal position after the completion of the operation, either of itself or by gently pressing the lower lid with the finger on the margin of the cornea, the blunt probe may be introduced from the side into the anterior chamber, and passing it along the iris angle beyond the vertical meridian, the iris may be disengaged and gently stroked towards the pupil. If efforts to replace the iris fail, or it shows a disposition to become displaced, a small portion of it may be excised, thus forming an iridectomy.

The conjunctival flap when present should be kept out of the wound. It is important in all manipulations that the edges of the lids do not come in contact with the corneal section.

*Dressing of the Eye.*—The patient may be allowed to remain for some time on the operating table, or may be put to bed at once, and after the lapse of half an hour, the eye should be inspected, when, if everything is all right, the bandage is applied, both eyes being covered. Before bandaging the eye, in cases where an iridectomy has not been performed, a solution of eserine may be instilled. This will have a tendency to draw the iris away from the corneal inci-



sion. An ointment of boric acid and white vaseline should be smeared along the edges of the lids, and the gauze, covered with the ointment, should be placed against the lids. Over this, small pieces of cotton may be packed, being careful to have the shape conform to that of the eyeball, and also that no extreme pressure is made, as union may be delayed. The bandage may then be applied, both eyes being covered, and the patient required to lie on the back for forty-eight hours, as a rule. If no pain is experienced by the patient the eye should not be opened under three days. The dressing, however, may be changed if it will conduce to the comfort of the patient.

Other methods of protecting the eye are used, but as a rule are not more comfortable than a light bandage.

I prefer to have the patient in a moderately light room, as acute mania is more liable to occur when patients are kept in a dark room. Direct exposure to sunlight, however, should be avoided.

The operation described is without an iridectomy.

There are various modifications of this operation. The corneal section may be in the opaque border. Prolapse of the iris and vitreous and inflammation of the ciliary body are more frequently found in this method.

The section may be entirely within the transparent cornea. Adhesions of the iris to the scar and less complete closure usually result. A downward section is sometimes made, but unless there is some complication that demands this section, it is not advisable to make it.

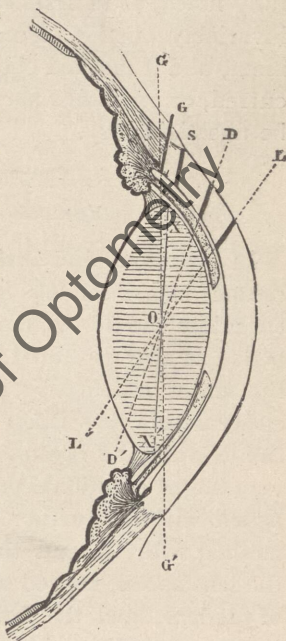


FIG. 174.—Positions of the sections advocated by various operators. — Noyes.

PRELIMINARY IRIDECTOMY.—This operation is advised by a number of operators, the operation being performed a few weeks before the extraction. When an iridectomy is performed during the operation, it is a *combined extraction*.

An iridectomy is indicated in cases where the pupil will not permit of the escape of the lens. In cases in which synechiæ are present, an iridectomy may have to be performed, as well as in cases where there is a hazy condition of the cornea, for the purpose of making an optical pupil.

Before operating on any case of cataract, the condition of the deeper structures of the eye should be ascertained as nearly as possible. A fluid condition of the vitreous, or a glaucomatous state, would counter-indicate an operation. The projection and perception of light should also be carefully noted, as in cases of hard cataract the object is almost invariably not for cosmetic effects, but for visual improvement, and if marked choroidal or retinal changes have occurred, or extensive nerve lesions are present, the result will be unsatisfactory.



FIG. 175.—Tyrrell's Sharp Hook.

In tremulous and dislocated cataracts, or if the vitreous escapes before the lens is removed, the fixation forceps and speculum should be immediately removed, and the lens expelled as already stated by pressure on the lower lid towards the center of the globe, and counter-pressure on the sclerotic, either with a lens scoop or the upper lid. By this maneuver the lens may be coaxed into the incision, and closing it, a very slight additional pressure may cause the lens to be expelled without further loss of vitreous. Very rarely this method will fail, and the lens will have to be removed by the lens spoon, curved wire loop, or sharp hook, passed back of the lens, and the lens removed with these instruments, but as a rule this will not be necessary.



ACCIDENTS DURING THE OPERATION.—When the corneal section is not made sufficiently large, considerable of the cortex will be removed in its passage through the incision, and also bruise the edges, which retards healing. This mistake will be recognized when the lens presents in the corneal wound, but remains stationary. Forcible pressure should not be used in these cases, but the section should be enlarged by the use of a strong pair of strabismus scissors.

The point of the knife may catch in the iris in its passage through the anterior chamber, or the counter-puncture may be in an improper position. When either of these occurs, the knife should be drawn backward until freed from the iris or the cornea, and an attempt made to complete the counter-puncture without the complication again occurring.

The iris may fall over the knife after the counter-puncture is made and the upward section commenced. The iris can frequently be returned to its proper position by slightly turning the edge of the knife outward; if this should fail the section should be completed, as the small portion of iris cut off will interfere but slightly with a good recovery.

If accidentally the knife should be introduced with the cutting edge in the wrong direction, it should be withdrawn and again inserted, but if there has been an escape of aqueous, so that this cannot be done, the operation will have to be postponed until the anterior chamber has refilled. This is a mistake which is virtually inexcusable. On fine cutting instruments, the name of the manufacturer is usually on the back of the instrument, so there should be no difficulty in knowing which is the cutting edge.

The laceration of the capsule may not be sufficient, and the lens will fail to push forward when pressure upon the lower portion of the cornea is made. If this should occur the cystotome should be again introduced and more extensive laceration of the capsule made.

In some instances there is a thickened condition of the capsule at the center which prevents free laceration. This may have to be removed by the aid of capsule forceps.

ANOMALIES IN HEALING.—PAIN.—A slight pain is usually present after the operation and is of no importance. A severe pain may result from intra-ocular hemorrhage, iritis, irido-cyclitis, or suppuration of the wound. Profuse intra-ocular hemorrhage during or following an operation is always a serious complication, the eye being lost under almost any circumstances. When intra-ocular hemorrhage occurs soon after the operation there will be severe pain, and the bandage may show blood stains, or vomiting may occur. On removing the bandage a blood-clot may be found protruding through the palpebral fissure, and when the upper lid is raised, the anterior chamber will be seen filled with blood, and the corneal wound will be widely separated. Knapp advises in these cases placing the patient in an upright position and giving a hypodermic injection of morphine, carefully removing the blood, washing out the conjunctival sac with a weak bichloride solution, and the dressing reapplied. The dressing should be changed once or twice a day. Suppuration may possibly be avoided by this means, but blindness will be permanent. If the pain becomes too severe and the hemorrhage continues, enucleation should be performed,

SUPPURATION OF THE WOUND.—Where proper precautions have been taken in preparing the patient, the hands of the operator, and instruments, this is an infrequent complication. When it does occur, the cornea, iris, or vitreous, or all of them, may be affected. Panophthalmitis generally follows with destruction of the globe.

When the suppurative process is not extensive, it may terminate without destruction of the eye, but the vision will be very much reduced or destroyed, the pupil occluded and drawn to one side. If the suppuration is confined to the lips of the corneal incision, after healing has occurred, and the eyeball is not soft, and perception of light is good, an iridectomy may give a moderate amount of vision.

The treatment in these cases should be the same as already given under suppurative inflammatory action.



**IRITIS.**—This seldom makes its appearance before the fifth day, but may be delayed to a later period. It may result from imperfect removal of the cortex, faulty manipulation during the operation, or to early exposure of the eye to light.

Treatment does not vary from that already given under iritis.

Cyclitis may make its appearance the second week. There will be deep seated pain and pericorneal injection. The pupil may be round and clear. The treatment should be that already described under cyclitis and continued until the sclera is normal in appearance, and the vitreous clears. Opacity of the capsule is generally present in these cases, and dissection will be required.

**IRIDO-CYCLITIS.**—This is extremely chronic in its course, and usually results in occlusion of the pupil, with a dense, false membrane behind the iris. If there is perception of light in these cases, after the disease is cured, a secondary operation may give good vision.

**BULGING OF THE CICATRIX.**—In some cases, after one or two weeks, the cicatrix will be found to bulge; it may be at either extremity or throughout the entire extent of the wound. This has the appearance of a vesicle-like, semi-transparent elevation. The iris is usually entangled in the cicatrix; irido-choroiditis may follow.

**GLAUCOMA FOLLOWING EXTRACTION.**—This may appear after an iritis, where extensive posterior synechiæ are present, and with the formation of a false membrane. Glaucoma may also follow dissection.

**OPACITIES OF THE CORNEA AND KERATITIS.**—Corneal opacities are very frequently the result of the use of strong antiseptics, a solution of bichloride of mercury being frequently a cause. The epithelium may be roughened, or a milky-white appearance of the posterior surface of the cornea may be present. This is a permanent condition.

Striated keratitis following cataract operations is a not uncommon complication. It consists of fine lines of opacity radiating in different directions, but usually disappears in a few days.

PROLAPSE OF THE IRIS.—When this occurs there is usually sudden pain, which gradually diminishes. This may result from rough handling of the eye, and has also been caused by paroxysms of coughing, violent exertion, etc. If the condition is discovered within a few hours after its occurrence, the prolapsed portion should be excised, and the edges of the iris reduced as after an operation for iridectomy. Knapp advises non-interference if the condition is not discovered before the third or fourth day. After the irritation has subsided, the iris may be excised in a manner similar to that for a small staphyloma.

Besides the simple extraction two others may be noted. The modified or peripheral linear extraction, or Von Graefe's method. In this the puncture is made 1 mm. external to the corneal margin and 2 mm. below the tangent of its summit. When the point of the knife has entered the anterior chamber, it is directed toward the center of the cornea. After it has been introduced 7 or 8 mm. the handle is depressed and the counter-puncture is made at a point opposite to that of the puncture. The edge of the knife is directed obliquely forward, the section being completed by an upward sawing movement. The conjunctival tissue is severed by directing the edge of the knife forward, or a little upward if a conjunctival flap is desired. In these cases an iridectomy is performed.

Objections to this operation are the danger of hemorrhage from the conjunctiva, loss of vitreous and cyclitis.

SHORT OR 3 MM. FLAP OPERATION.—The puncture is at the sclero-corneal junction at the upper extremity of a horizontal line, which would pass 3 mm. below the summit of the cornea. The flap includes about one-fourth of the cor-



neal diameter. The remainder of the operation does not vary from those already described.

**CAPSULE OPERATIONS** — Secondary or after Cataract. — Many operative procedures have been advocated for so-called secondary cataract. Discission is indicated where the pupillary obstruction can be divided with a small knife or needle. In the majority of cases, after the extraction of a cataract, the posterior portion of the capsule does not remain clear, but becomes wrinkled or thickened, or there may be points of opacity which interfere with vision. When the vision is less than 20-50 an operation is advisable.

Prior to the operation the eye should be carefully examined with the ophthalmoscope to determine whether the visual defect is due to the capsular condition or to fundus changes. If a distinct view of the fundus is obtainable, an operation should not be performed.

With the pupil fully dilated and the eye anesthetized with cocaine, a strong light should be concentrated on the pupil, leaving the part of the cornea, through which the operator looks, unilluminated. The knife needle is usually employed and the capsule divided by making two incisions T-shaped, or three incisions may be necessary + crucial. Tough and inelastic bands must be avoided, clearing the space between them. The needle should not pass further in the vitreous than is absolutely necessary to divide the capsule. If the capsule has not been sufficiently opened, the operation may be repeated either at the same or a later sitting.

In this operation it is important that the shank of the knife needle should be properly proportioned, so that the corneal wound is just filled, thus preventing the escape of aqueous, which would occur if it were too small, and yet allowing freedom of motion, which would be prevented if the shank were too large. The eye is bandaged for twenty-four hours.

Reaction is usually slight if any. Glaucoma may sometimes follow this operation, and the patient should be cau-

tioned against any over-exertion for five or seven days after the discission. When the capsule is very tough, a double-needle operation may be performed, the operation being performed in the same manner as the double-needle operation in soft cataract.

OPERATIONS UPON THE EYE MUSCLES.—Operations on the muscles are divided into complete and partial tenotomies, advancement or readjustment.



FIG. 176.—Strabismus Hook.

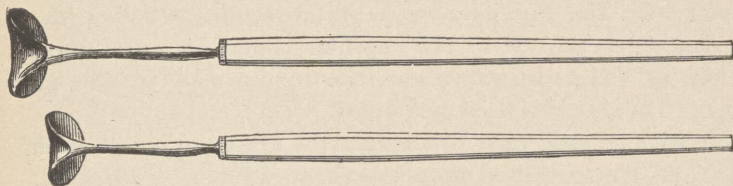


FIG. 177.—Demarre's Lid Elevators.

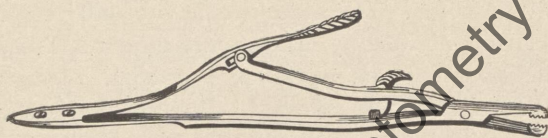


FIG. 178.—Sands' Needle Holder,



FIG. 179.—Knapp's Antiseptic Needle Holder.

For a tenotomy, the instruments required are two strabismus hooks, fixation forceps, plain or probe pointed scissors, needle holder, needles, silk, speculum or lid elevator. There are numerous operations advocated for tenotomizing the muscles, but the one which has given the best results in my hands is the operation of Panas. General anesthesia is



necessary in this operation. In cases of strabismus it is usually necessary to either advance the antagonizing muscle, or to tenotomize the corresponding muscle on the fellow eye.

In the Panas operation, after the patient is ready for the operation, the conjunctiva is seized with fixation forceps, and a cut is made over the center of the muscle parallel with its direction. After the incision has been made, a strabismus hook is passed under the muscle, and when it is thoroughly engaged, the eye is rotated, in convergent strabismus outward until the inner margin of the cornea is hidden behind the external canthus. This pull on the muscle must be made steadily, and there is no danger of rupturing the muscle in this way. If it is the external muscle which is to be divided, the rotation is then made inward to the nasal or inner canthus. After traction has been made, the muscle is divided. The fellow eye is treated in a similar manner. The conjunctival wound is closed by a single suture. Reaction is seldom severe and a second operation is not often required. This of course is only applicable in cases of complete tenotomy.

*Complications.*—The capsule of Tenon may not be divided, when this occurs the hook will not engage the tendon of the muscle. This will be recognized when, on drawing the hook toward the cornea, it will be found to engage simply the conjunctival tissue.

Hemorrhage may be severe, but this rarely occurs. The blood may be profuse enough to cause protrusion of the eye, and in some cases atrophy of the optic nerve through pressure has occurred. A firm pressure bandage should be applied. The protrusion of the eyeball will gradually subside and the blood be absorbed.

ORBITAL CELLULITIS, TENONTITIS.—Either of these complications may follow a tenotomy, but are rare. The treatment will be similar to that already given.

**PERFORATION OF THE SCLERA.**—This is an accident which does not often occur, but has been frequent enough to demand recognition. It probably never will happen if probe-pointed, or blunt scissors are used.

**RETRACTION OF THE CARUNCLE.**—In operations on the internal recti muscles, there is always more or less retraction of the caruncle. It is probably due in part to retraction of the muscle, but when extensive, probably results from too extensive loosening of the tissues. If the defect is very marked, the retracted tissue may be loosened and the caruncle stitched into place.

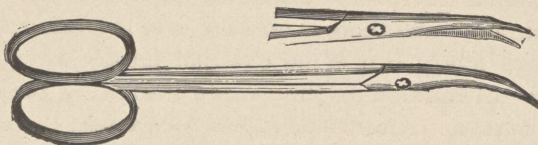


FIG. 180.—Stevens' Scissors.



FIG. 181.—Stevens' Delicate Curved Tenotomy Forceps.



FIG. 182.—Stevens' Delicate Straight Tenotomy Forceps.



FIG. 183.—Stevens' Delicate Fixation Forceps.

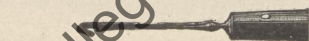


FIG. 184.—Stevens' Traction Hook.



FIG. 185.—Stevens' Tendon Divulser.

**PARTIAL, OR GRADUATED TENOTOMY.**—Graduated tenotomies are performed for those conditions described under insufficiency of the ocular muscles. The operation of Stevens



is most generally performed. By the use of a pair of small, narrow bladed scissors a transverse incision is made in the conjunctiva corresponding to the line of insertion of the tendon. This is grasped behind, but near its insertion, and by dividing the center of the tendon, a small opening is made to the sclera; this opening is then enlarged by careful cuts with the scissors toward either edge, keeping close to the sclera. The judgment of the operator will determine the amount to be divided, and is also tested by placing the patient before a lighted candle and making a test of the muscle strength.

ADVANCEMENT.—In this operation the tendon of the rectus muscle is brought forward and a new attachment formed. The operation is employed where the tendon has become weakened, as in myopia associated with divergent strabismus, or in cases where it is necessary to combine advancement with tenotomy, as well as in cases in which a tenotomy has been performed on the interni or externi muscles producing an over-correction. General anesthesia should be employed, as the operation is tedious and painful.

PRINCE'S METHOD.—A conjunctival incision is made over and parallel to the attachment of the tendon. The tendon is grasped by an advancement forceps, separated from the sclera and drawn forward, allowing the conjunctiva to retract. Iron-dyed silk No. 3, with a slender eye needle at each end, is used, passing the needle from within outward at the upper and lower border of the tendon, perforating the capsule, muscle, and conjunctiva at a point depending upon the amount of correction required. This secures the middle portion of the muscle in a sling. The portion of the tendon included in the forceps is divided about 2 mm. anterior to the loop. Either needle is then passed vertically through the tissues 2 mm. from the sclero-corneal junction. The ends of the suture being brought together and tied on one of the horizontal sides, can be tightened to produce a slight over-correction. The knot may be secured, or temporarily

held by making a bow knot, until muscular tonicity has returned. This enables the operator to modify the correction at any time before adhesion has taken place.



FIG. 186.—Prince's Advancement Forceps.

The suture is allowed to remain for four days, unless over-correction has been made, which can be remedied with safety after forty-eight hours by removing the suture and cautiously opening the wound.

**ADVANCEMENT OF TENON'S CAPSULE.**—(Knapp's Modification of DeWecker's Method).—A vertical incision through the conjunctiva is made over the insertion of the tendon, and the conjunctiva around the cornea to the vertical meridian is loosened. At the lower margin of the tendon, Tenon's capsule is divided with scissors, and a strabismus hook passed under the tendon, and rotated to bring the tip of the hook forward at the upper margin. The capsule is divided at this point also. Three or four sutures are introduced. The external ones, passing through the conjunctiva and corresponding edges of the muscle, are passed obliquely forward under the conjunctiva until near the vertical meridian, when the needles pass through 2 or 3 mm. of the external scleral layers before emerging. The third suture passes through the tendon and middle of the muscle, under the hook, through the middle of the tendon close to its insertion, and through the external scleral tissue, passing out through the conjunctiva near the corneal margin. A fourth suture may be employed in a similar manner to the third suture, when an extreme effect is required. The sutures are tied and allowed to remain five or six days.

**OPERATIONS UPON THE LACHRYMAL APPARATUS.**—Removal of the lachrymal gland. Two methods for removing the gland are employed. An incision may be made through the skin of the upper lid, parallel with the orbital margin,



which will expose the gland, which may be drawn out with a tenaculum, and separated from its attachments by knife or scissors. The levator palpebræ superioris is more or less implicated in this operation, and ptosis may result.

Velpéau recommends dividing the external canthus and everting the upper lid, when the gland can be cut down upon from the superior cul-de-sac. The levator muscle is not liable to be injured in this method.

**FISTULA OF THE LACHRYMAL GLAND.**—Bowman's operation is to make an opening into the conjunctival sac in place of the external cutaneous fistula.

A threaded needle is introduced a short distance into the fistula, then transfixes the lid on the conjunctival surface. A second needle at the other end of the thread is passed through the lid close to the fistulous opening, and the thread is tightly tied and allowed to cut its way out. The edges of the external fistula should be freshened, when it will usually close.



FIG. 187.—Weber's Straight Canaliculus Knife.

**SLITTING THE CANALICULUS.**—In this method a probe-pointed knife is used. The lid should be drawn slightly downward and outward with the thumb or finger, so as to put the tissues on the stretch, and the probe-point of the knife is introduced vertically into the punctum. The direction of the knife is changed by bringing the handle into a horizontal position, and pushing the blade along the canal until the point touches the inner wall of the lachrymal sac, keeping the lid tense; the handle of the knife should then be raised to a vertical position, turning the edge of the blade slightly inward, and the tissues divided to the sac. Either the upper or lower canaliculus may be opened, but if the upper, a reversal of the positions will be required.

The edges of the incision, as a rule, show a tendency to reunite, and for several days it will be necessary to separate the edges every day or two by passing a probe.

USE OF LACHRYMAL PROBES.—When the canaliculus has been divided, the probe is introduced in a manner similar to the introduction of the canaliculus knife, and is passed horizontally until it touches the lachrymal bone; the tissues

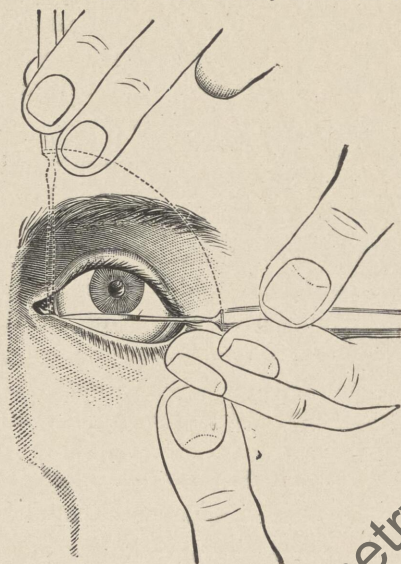


FIG. 188.—Method of holding knife and lid. Dotted line represents the position of the knife when the operation is completed.

must be kept tense with the thumb or finger, as in the operation for slitting. When resistance is felt, by the probe touching the bone, the probe should be raised to a vertical position and pushed into the duct, the direction being downward, slightly backward and outward. Care should be exercised in handling the probe, as the tissues may be injured by rough manipulation, or a false passage made. When the canaliculus has not been slit, the size of the probe which can be introduced through the punctum is usually small, and it can be passed down through the nasal duct without an undue amount of pressure. If the canaliculus has been divided, a larger probe may be employed, and as large as can be readily introduced should be used.



If a stricture is encountered in the nasal duct, it may be divided by means of a special knife with a flexible shank, or the knife used in slitting the canaliculus may be employed.

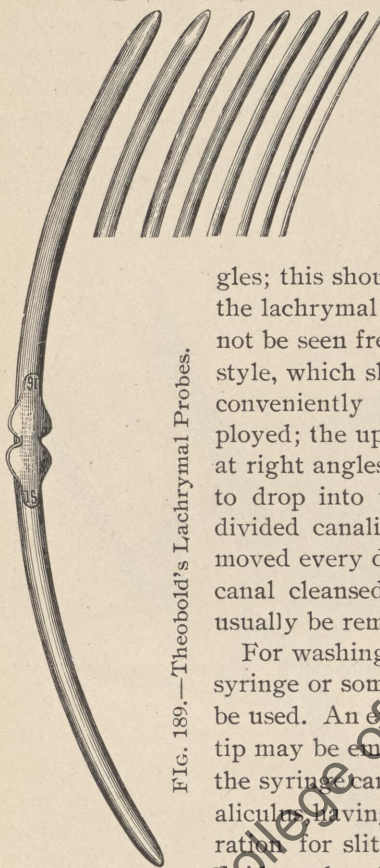


FIG. 189.—Theobald's Lachrymal Probes.

The knife should be passed through the sac into the nasal duct, dividing the stricture, which, if it seems firm, may be incised two or more times, rotating the handle of the knife so as to bring the incision at different an-

gles; this should be followed by the use of the lachrymal probe. Where the case can not be seen frequently, the use of a leaden style, which should be as large as can be conveniently introduced, should be employed; the upper end of the style is bent at right angles, and should be small enough to drop into the groove formed by the divided canaliculus. This should be removed every day or so, and the sac and canal cleansed. After a few weeks it can usually be removed permanently.

For washing the lachrymal sac an Anel syringe or some of its modifications may be used. An eye pipette with a fine curved tip may be employed. The fine point of the syringe can be introduced into the canaliculus, having the lid tense as in the operation for slitting the canaliculus. The fluid employed can be thrown into the sac and duct, giving it a thorough flushing.

In cases where the punctum is so contracted that the point of the syringe cannot be introduced, or there is difficulty in introducing the probe point of the canaliculus knife, dilatation of the punctum can be made. A very convenient in-

strument being the triangular probe found in the ordinary pocket case of instruments.

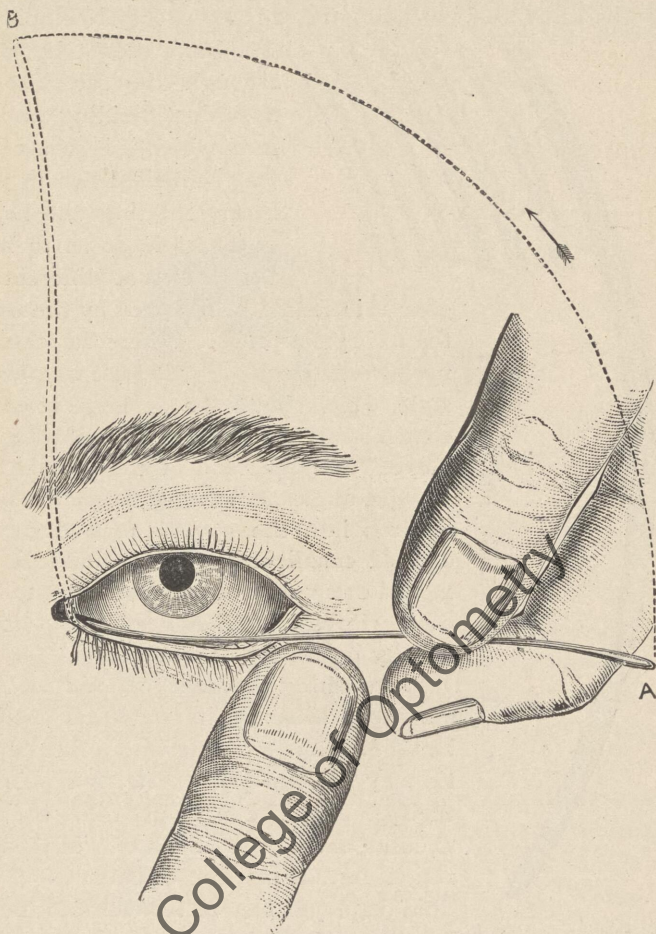


FIG. 190.—Method of Introducing Probe.—*Juler.*

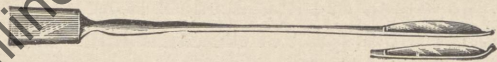


FIG. 191.—Noyes' Flexible Shank Canaliculus Knife.



**EXCISION OF THE LACHRYMAL SAC.**—This operation is not often performed, and is attended with considerable difficulty. When necessary to perform this operation, an incision is made through the skin and internal palpebral ligament until the sac is reached; this should be dissected as carefully and completely as possible with a scalpel or blunt-pointed scissors. The cavity should be scraped with a sharp spoon and thoroughly cleansed, closing the incision with sutures and suitable dressings.

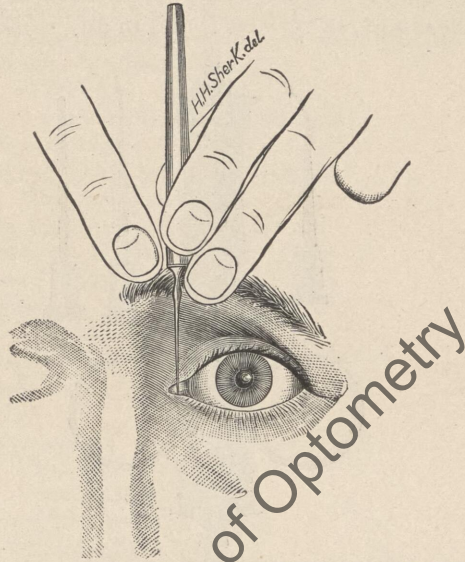


FIG. 192.—Dividing Stricture in the Nasal Duct.

**DESTRUCTION OF THE LACHRYMAL SAC BY CAUSTICS.**—This may be done by the use of galvano or thermo-cautery, or various caustic agents, as nitrate of silver and chloride of zinc, have been employed. The method generally employed is to make a free incision through the integument and palpebral ligament into the sac. The operations for the excision or destruction of the sac are not in general use, and should not be undertaken except by one skilled in this class of operations.

## OPERATIONS ON THE ORBIT.

In abscess of the orbit as already described, the incision should be made with a narrow knife, passed deeply enough to reach the abscess. If necessary the knife must be made to penetrate the integument as well as the tissues of the orbit. Free drainage should be maintained as long as any secretion is formed. The different forms of tumors which may be found in the orbit have been described, and the operative procedures necessary have been described under proper headings, or may be found in any work on Surgery.

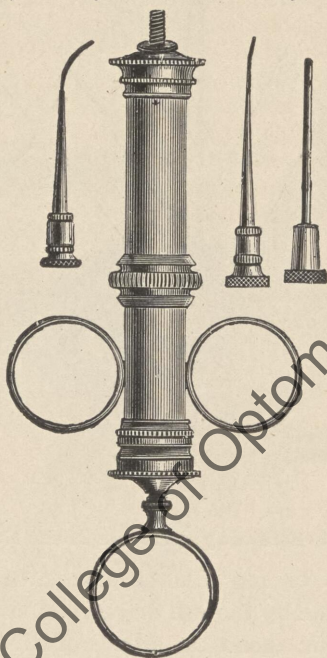


FIG. 193.—Anel Syringe.



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